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NAVIGATION CONDITIONS AT ABERDEEN LOCK AND DAM, TOMBIGBEE RIVER--ETC(U)
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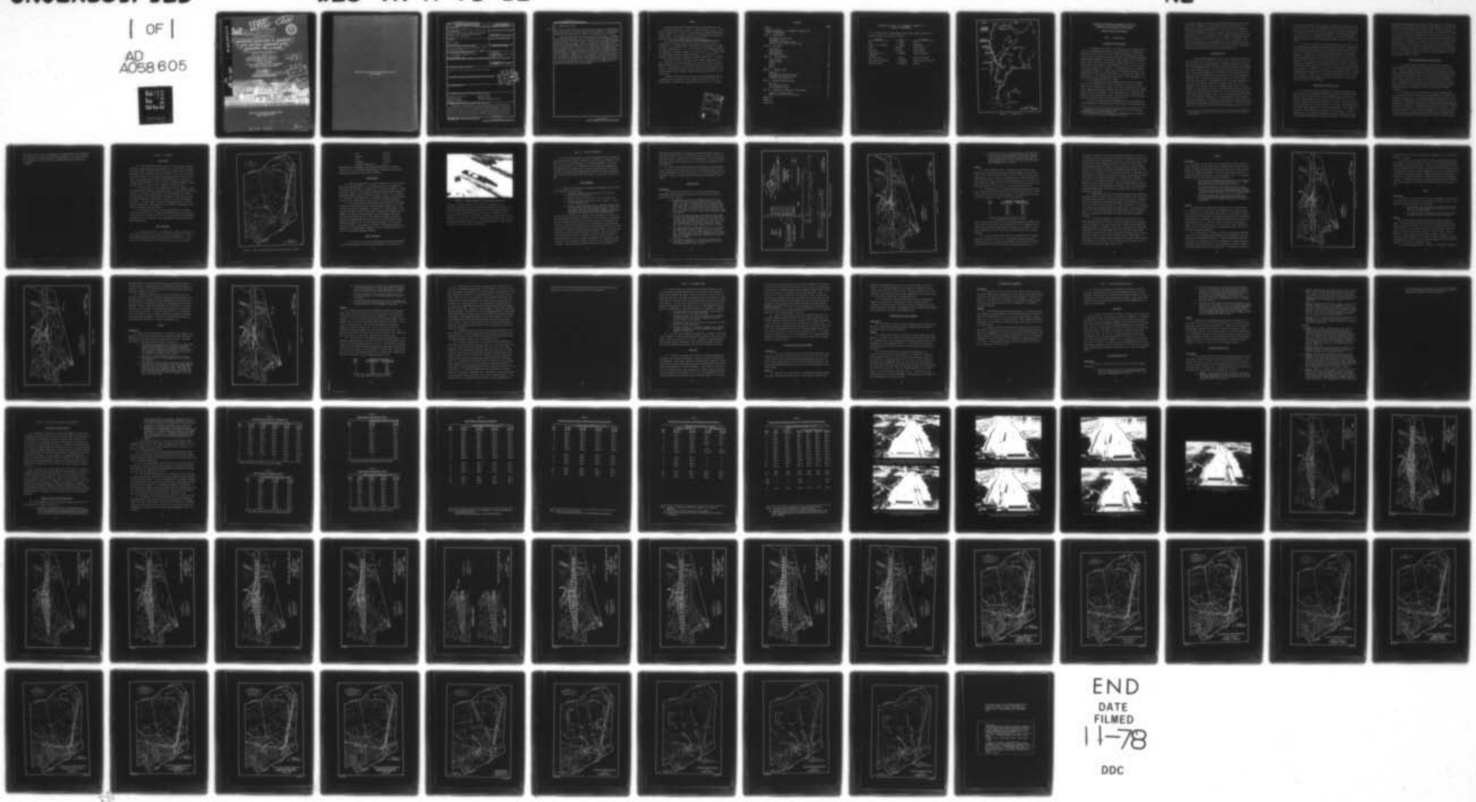

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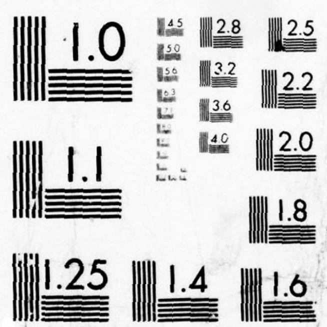

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TECHNICAL REPORT H-78-12

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NAVIGATION CONDITIONS AT ABERDEEN LOCK AND DAM, TOMBIGBEE RIVER MISSISSIPPI AND ALABAMA,

Hydraulic Model Investigation.

by

10 Louis J. Shows, John J. Franco

12 77p.

Hydraulics Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

11 Jun[redacted]78

9 Final Report. Jan 74-Oct 75,

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Prepared for U. S. Army Engineer District, Mobile
Mobile, Alabama 36628

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Technical Report H-78-12	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) NAVIGATION CONDITIONS AT ABERDEEN LOCK AND DAM, TOMBIGBEE RIVER, MISSISSIPPI AND ALABAMA; Hydraulic Model Investigation		5. TYPE OF REPORT & PERIOD COVERED Final report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Louis J. Shows John J. Franco		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Hydraulics Laboratory P. O. Box 631, Vicksburg, Mississippi 39180		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineer District, Mobile P. O. Box 2288 Mobile, Alabama 36628		12. REPORT DATE June 1978 13. NUMBER OF PAGES 73
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Aberdeen Lock and Dam
Hydraulic models
Locks (waterways)
Navigation conditions
Navigation dams
Tombigbee River
Tennessee-Tombigbee Waterway

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Aberdeen Lock and Dam will be the fourth structure proposed for the development of navigation on the Tennessee-Tombigbee Waterway. The lock and dam will be located in a bypass canal about 407.98 miles above the mouth of the Mobile River, or about 1 mile east of Aberdeen in Monroe County, Mississippi. The structures are designed to maintain a minimum upper pool during low flows extending 18 miles up the Tombigbee River and about 1.5 miles up Town Creek and into the Canal Section. The structures will include one lock

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20. ABSTRACT (Continued).

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with clear chamber dimensions of 110 by 600 ft and a dam with a 6-gated spillway section located in a bypass canal on the left overbank. A fixed-bed model reproduced about 1.0 mile of the Tombigbee River channel, the lock approach canal, and the adjacent overbank areas to an undistorted scale of 1:120.

The model investigation was concerned with the development of satisfactory navigation conditions in the lock approaches, the distribution of flow through the gated spillways, and the effects on stages of the cofferdam, landfills, and relocation of the railroad. Results of the investigation revealed that satisfactory navigation conditions would require modification of the excavation in the upper approach to the lock and dam, a dike forming an extension of the upper guard wall, and a short wing dike near the downstream end of the riverward lock wall. Distribution of flow through the gated spillway, particularly in the two gate bays near the lock, would be adversely affected by the alignment of currents approaching the structure, but the drop in water-surface elevation through the spillway and along the lock and lock walls would not be excessive. Construction of the cofferdam for the lock and dam would have little effect on water-surface elevations and velocities in the area, but the cofferdam and landfills could cause an increase in stages of as much as 1.7 to 2.0 ft with the higher flows. Relocation of the north-south section of the railroad would have little effect on water-surface elevations with adequate openings provided in the embankments.

PREFACE

The model investigation reported herein was authorized by the U. S. Army Engineer District, Mobile, on DA Form 2544, Order No. 74-044, dated 9 January 1974, to the U. S. Army Engineer Waterways Experiment Station (WES). The study was conducted in the Hydraulics Laboratory of WES during the period January 1974 to October 1975.

The investigation was conducted under the general supervision of Messrs. H. B. Simmons, Chief of Hydraulics Laboratory, and F. A. Herrmann, Jr., Assistant Chief of the Hydraulics Laboratory, and under the direct supervision of J. E. Glover, Chief of the Waterways Division. The engineer in immediate charge of the model was Mr. L. J. Shows, Chief of the Navigation Branch, assisted by Messrs. R. T. Wooley and J. L. McGregor. This report was prepared by Messrs. Shows and J. J. Franco.

During the course of the model study, Messrs. Wayne Odom, A. F. Baer, Bobby Felder, and Fred Thompson of the Mobile District visited WES at different times to observe special model tests and discuss the results. The Mobile District was kept informed of the progress of the study through monthly progress reports and special reports at the end of each test.

Directors of WES during the course of the investigation and the preparation and publication of this report were COL G. H. Hilt, CE, and COL John L. Cannon, CE. Technical Director was Mr. F. R. Brown.

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CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
feet	0.3048	metres
miles (U. S. statute)	1.609344	kilometres
acres	4046.856	square metres
acre-feet	1233.482	cubic metres
square miles (U. S. statute)	2.589988	square kilometres
feet per second	0.3048	metres per second
cubic feet per second	0.02831685	cubic metres per second
degrees (angle)	0.01745329	radians

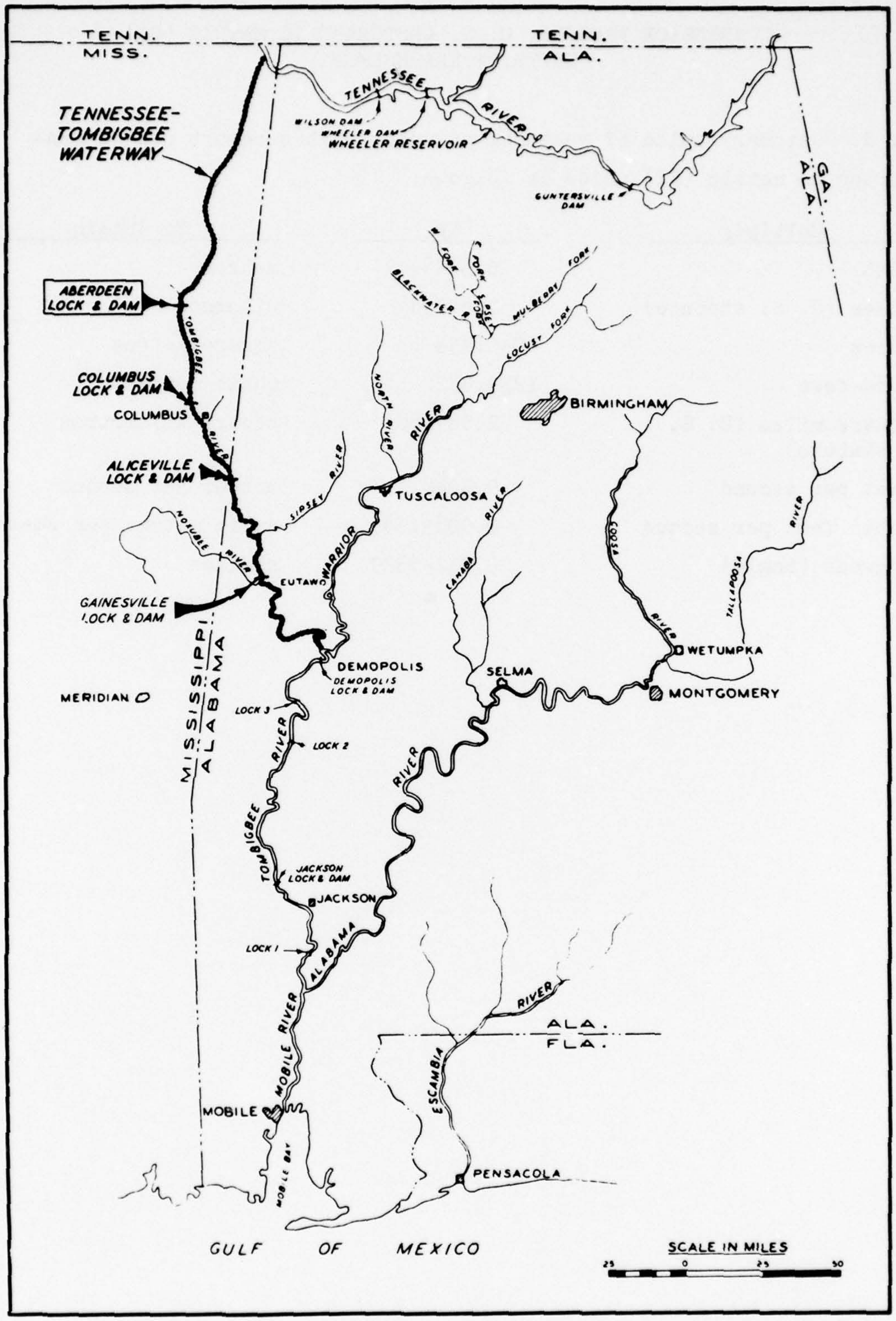

Figure 1. Vicinity map

NAVIGATION CONDITIONS AT ABERDEEN LOCK AND DAM
TOMBIGBEE RIVER, MISSISSIPPI AND ALABAMA

Hydraulic Model Investigation

PART I: INTRODUCTION

Description of Prototype*

1. Aberdeen Lock and Dam, to be constructed in northeast Mississippi on the Tombigbee River about 177 miles** above the confluence of the Warrior River and about 28 miles above the Columbus Lock and Dam site, will be the fourth navigation structure on the Tennessee-Tombigbee Waterway above Demopolis Lock and Dam. The proposed site for Aberdeen Dam is about 1 mile east of Aberdeen in Monroe County, Miss., at river mile 407.98 above the mouth of the Mobile River at the foot of Government Street, Mobile, Ala. (Figure 1). During low flow, the structure is designed to maintain a single upper pool extending upstream in the Tombigbee River about 18 miles and about 1.5 miles up Town Creek. The Canal Section of the waterway will begin about 4 miles downstream from the junction of Town Creek and the river.

2. The Tombigbee River above Aberdeen Dam site has a drainage area of 2,045 square miles or about 10 percent of the 20,100 square miles for the Tombigbee River basin. The river lies entirely within the coastal plain with elevations ranging from about 1,000 ft at the highest point to 160 ft at the damsite. The Tombigbee River is formed by the junction of the East and West Forks. From that source, the river flows 31 miles nearly due south to the Aberdeen Dam site.

3. The ridge separating the Tennessee River from the headwaters of the Tombigbee is situated about 15 miles south of the Tennessee River

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* Prototype information obtained from Aberdeen Lock and Dam Design Memorandum No. 2, dated February 1974.

** A table of factors for converting U. S. customary units of measurement to metric (SI) units is presented on page 3.

in extreme northeast Mississippi and divides the waters of Yellow Creek which flows northward into the Tennessee River from the waters of Mackeys Creek which flows southward to the East Fork of the Tombigbee. The Tennessee-Tombigbee Project as proposed will include a canal cut through this divide to el 395.0,* and will connect these rivers for navigation by means of locks and dams. At low stages, the Tombigbee River varies in width from 75 ft at its source to 400 ft at Demopolis. The principal tributaries of the Tombigbee River above Demopolis Lock and Dam are the East and West Forks which form the stream; the Buttahatchee, Tibbee, Sipsey, and Noxubee Rivers; and Luxapalila Creek.

Development Plan

4. The Tennessee-Tombigbee Project, first authorized in the 1946 River and Harbor Act, consists of three reaches: the River Section, the Canal Section, and the Divide Section. The River Section will consist of a 173.04-mile-long reach of river which will extend up the Tombigbee River from Demopolis, Ala., to a point just north of Amory, Miss., and will involve straightening the river channel and building conventional locks and dams near Gainesville and Aliceville, Ala., and Columbus and Aberdeen, Miss. The Canal Section will consist of a 45.6-mile-long canal that will parallel the Tombigbee River on the east separated from the river by levees from near Amory to Mackeys Creek near Old Bay Springs in the southwest corner of Tishomingo County, Miss., and will involve the construction of a canal, by excavation and levees, with five locks. The Divide Section will consist of a 39.3-mile-long canal that will extend from Bay Springs, Miss., to the Yellow Creek arm of Pickwick Lake on the Tennessee River near the common boundary of Mississippi, Alabama, and Tennessee, involving a 27-mile-long cut through the Divide separating the Tombigbee and Tennessee River basins. The River Section will be 9 ft deep and the Canal and Divide Sections will be 12 ft deep.

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* All elevations (el) cited herein are in feet referred to mean sea level (msl).

The bottom width will be 300 ft, except in the actual Divide Cut, where it will be 280 ft. The lock chambers will be 110 ft wide by 600 ft long and will have a depth of 15 ft over the miter gate sills, corresponding to the new locks on the connecting waterways. The locks will provide a total lift of 341 ft to overcome the difference in elevation between Demopolis Lake on the Tombigbee River and Pickwick Lake on the Tennessee River.

5. The major portion of the prospective commerce consists of upbound movement of commodities that normally move in bulk. Virtually all the upbound commerce originates in the immediate trade areas of the Gulf ports or at industries or producing areas along the Gulf Intracoastal Waterway. Upbound traffic originating at New Orleans or west thereof would terminate generally along the upper Tennessee River; traffic originating at Mobile or ports to the east, owing to the greater distance advantage in comparison with the Mississippi River, would be distributed over a much broader area along the Ohio and the upper Mississippi Rivers and tributaries. Similarly, a large part of the downbound traffic would terminate along the Gulf coast or be exported through the ports of Mobile or New Orleans. Shippers and receivers along the Warrior River, principally Tuscaloosa and Birmingham, would also contribute an appreciable volume of traffic to the waterway.

Description of Proposed Plan

6. The general design of Aberdeen Lock and Dam provides for a navigation lock, a concrete-gated spillway, concrete fixed-crest spillways, and overflow and nonoverflow earth dikes. The structures will provide a normal upper pool at el 190.0 with a normal lift of 27 ft in the lock chamber from the Columbus pool at el 163.0. The lock and dam will be constructed in a bypass canal in the left or east riverbank with an abutment wall between the lock and gated spillway. The spillway will contain six 60-ft-wide gates with gate sill at el 165.0. A concrete abutment wall will connect the spillway to an earth mound to the east which has been designated for public use purposes. An access overflow

dike will extend eastward from the mound to high ground. A nonoverflow earth-fill dike extending from the earth mound adjacent to the west side of the lock in a northwesterly direction across the Old River channel will tie into high ground along the right bank. A culvert will be placed in the dike to provide a continuous flow of fresh water into the Old River channel. The lock and dam will be placed in a 7600-ft-long cutoff canal on the left overbank. At normal pool el 190.0, the reservoir will extend about 12.4 miles upriver to the entrance of the Canal Section, about 16.4 miles to the junction of Town Creek, and about 1.5 miles upriver of the junction. The pool which will have an area of 3,890 acres and a total volume of 27,800 acre-ft will be used exclusively for navigation and recreation purposes.

Need for and Purpose of Model Study

7. The general design of Aberdeen Lock and Dam was based on sound theoretical design practice and experience with similar structures. However, navigation conditions vary with location and flow conditions upstream and downstream of a structure, and an analytical study to determine the hydraulic effects that can reasonably be expected to result from a particular design is both difficult and inconclusive. Thus, a comprehensive model study was considered necessary to investigate conditions that could be expected with the proposed design and to develop modifications required to ensure satisfactory navigation conditions.

8. Locations of the lock and dam and the lock approach canal were fixed at the time the model study was undertaken. Therefore, the purpose of the model was to determine navigation conditions in the lock approaches, the approach canal, and flow conditions and discharge distribution at the dam with various riverflows and to develop modifications that might be required to eliminate any undesirable conditions. Specifically, the model was used to determine stages, current directions, and velocities with the proposed plan and modifications; conditions with various cofferdam plans; and the effects of railroad relocation plans.

The model was also used to demonstrate to navigation and local interests the conditions resulting from the proposed design and to satisfy them of its acceptability from a navigation, communication, and recreational standpoint.

PART II: THE MODEL

Description

9. The model included about 11,500 ft of the improved channel and cutoff canal forming the approaches to the lock and dam, the lock and dam, adjacent overbank areas, and special features of the proposed plan such as the landfill and public use area to the right of the lock and canal (Figure 2). The model also reproduced about 2 miles of the left overbank extending from the navigation channel to high ground to the east including about 3.2 miles of the St. Louis-San Francisco Railroad and about 2.1 miles of U. S. Highway 45 within the area.

10. The model was of the fixed-bed type with the channel, canal, and overbank areas molded in sand-cement mortar to sheet-metal templates. Portions of the model, where changes in bank alignments and channel configurations could be anticipated, were molded in pea gravel to permit easy modifications that might be required to provide satisfactory conditions. The lock, gated spillway, and abutment walls were fabricated of sheet metal. The dam gates were simulated schematically with simple sheet-metal slide-type gates.

11. The model was molded to the hydrographic and topographic surveys made in July 1972. Overbank areas were molded up to elevations of about 200.0 on the left and 212.0 on the right which were considered sufficient for the reproduction and investigation of flows that would affect navigation.

Scale Relations

12. The model was built to an undistorted linear scale ratio of 1:120, model to prototype, to obtain accurate reproduction of velocities, crosscurrents, and eddies that would affect navigation. Other scale ratios resulting from the linear scale ratio were as follows:

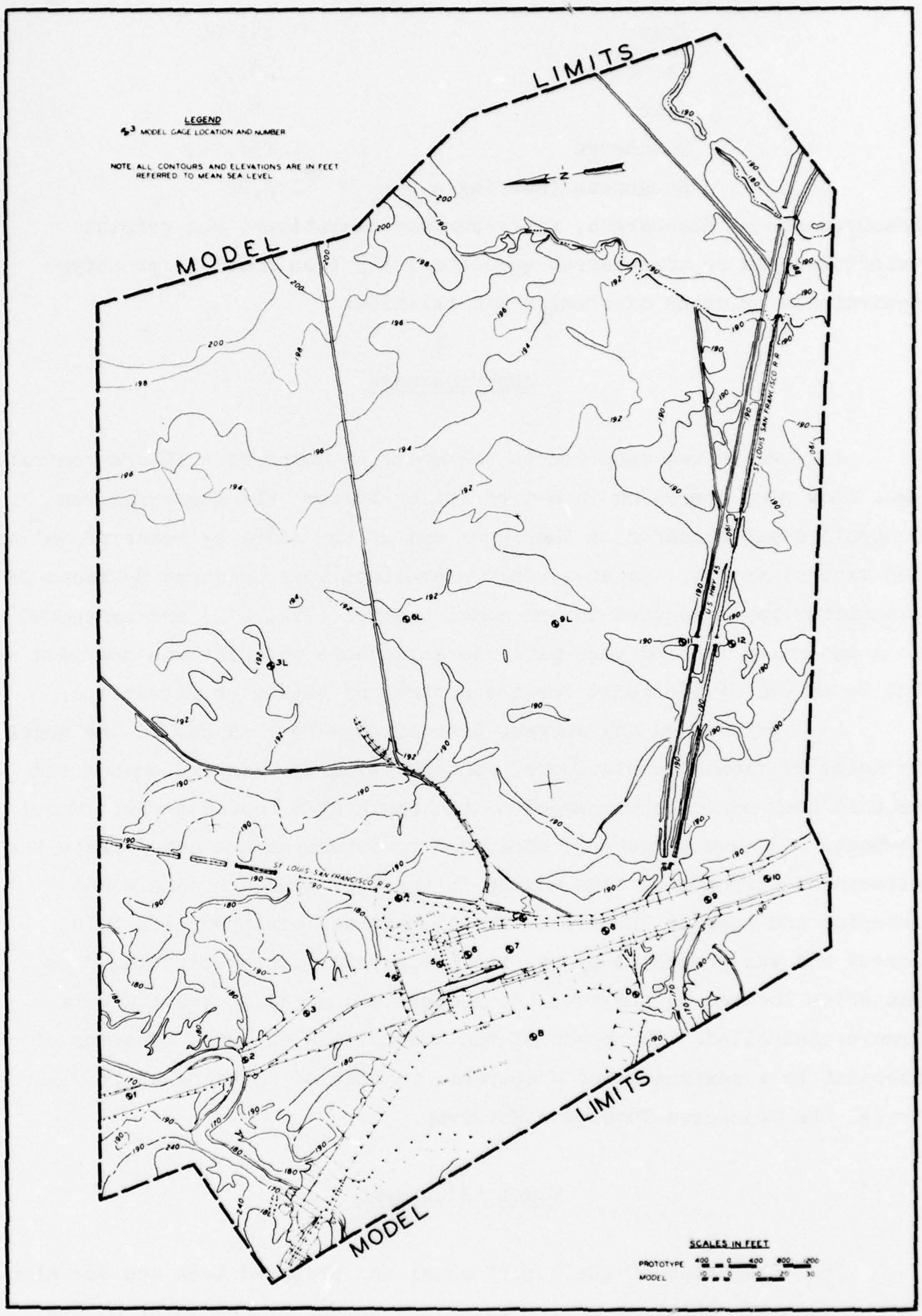


Figure 2. Model layout with proposed plan and gage locations

Area	1:14,400
Velocity	1:10.95
Time	1:10.95
Discharge	1:157,743
Roughness (Manning's n)	1:2.22

Measurements of discharges, water-surface elevations, and current velocities can be transferred quantitatively from model to prototype equivalents by means of these scale relations.

Appurtenances

13. Water was supplied to the model by means of a 10-cfs centrifugal flow pump operating in a circulating system; the discharge was controlled and measured at the upper end of the model by means of valves and venturi meters. Water-surface elevations were measured by means of piezometer gages located in the model channel (Figure 2) and connected to a centrally located gage pit. An adjustable tailgate was provided at the lower end of the model for the control of tailwater elevations.

14. Velocities and current directions were obtained in the model by means of floats consisting of wooden cylinders weighted on one end so that they would be submerged to the depth of a loaded barge. Model towboats and tows (Figure 3) were used to determine and demonstrate the effects of currents on tows moving in the lock approach canals and entering and leaving the lock. The towboat was equipped with twin screws and was propelled by two small electric motors operating from batteries located in the tow; the rudders and speed of the tow were remote-controlled. The power of the towboat was adjusted by means of rheostat to a maximum speed comparable to that of towboats which will travel the Tennessee-Tombigbee Waterway.

Model Adjustment

15. Inclusion of the cutoff canal and proposed lock and dam plan in the initial construction precluded adjustment of the model to the

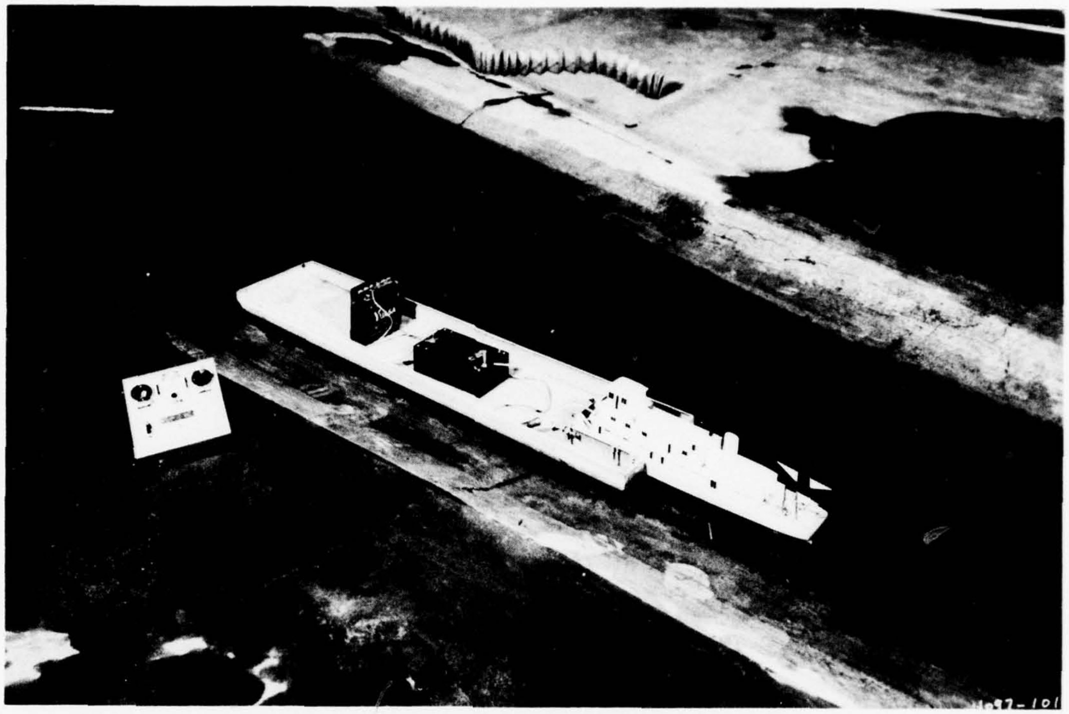


Figure 3. Model towboat and tow with remote-controls

existing prototype conditions. This type of adjustment was not considered necessary since the proposed improvements would involve considerable change from existing conditions. The model was constructed with a brushed cement-mortar finish to provide a roughness factor (Manning's n) of about 0.0135, which corresponds to a prototype channel roughness of about 0.030. Based on experience with other models of this type, brushed concrete gives a very close approximation of the roughness required to reproduce prototype conditions.

PART III: TESTS AND RESULTS

16. Tests in the model were concerned primarily with the study of flow patterns, water-surface elevations, velocities, and behavior of the model tow in the lock approaches with various riverflows. Since the worst conditions as far as navigation was concerned were obtained on the model during the higher river stages with uncontrolled riverflows, no tests were conducted to determine the effects of dam gate operation other than with flow distributed uniformly over the entire length of the dam.

Test Procedure

17. Tests were conducted by reproducing discharges that provided the following flow conditions:

- a. Controlled riverflows of 15,000 and 30,000 cfs with normal upper pool el 190.0.
- b. Maximum flow with normal pool el 190.0 (67,000 cfs).
- c. Maximum navigable flow (90,000 cfs), tailwater el 192.5, 25-year frequency flow.
- d. Flood flow (150,000 cfs) having a frequency greater than 100 years with a tailwater elevation of 200.7 with existing channel and 197.5 with project channel. This flow was used to determine water-surface elevations and local velocities with various railroad relocation plans.

The controlled riverflow was reproduced by introducing the proper discharge, setting the tailwater elevation for the discharge, and manipulating the dam gate openings until the required upper pool elevation was obtained. Uncontrolled riverflows were reproduced by introducing the proper discharge with dam gates fully open and manipulating the tailgate to obtain the proper tailwater elevation below the dam. All stages were permitted to stabilize before data were recorded. Current directions were determined by plotting the paths of wooden floats described in paragraph 14 with respect to ranges established for that purpose, and velocities were measured by timing the travel of the floats over known distances. General surface current directions were determined by

time-exposure photographs recording the movement of paper confetti on the water surface. No data were obtained with the model tow other than observations of its behavior in the lock approaches. Flow distribution along the length of the dam was based on velocity measurements through each gate bay.

18. Most of the modifications were developed during preliminary tests. Data obtained during these tests were sufficient only to assist in the development of a plan that appeared to provide the modifications required. Results of the preliminary tests are not included in this report.

Original Plan

Description

19. The principal features of the lock and dam structures, approaches, and modifications included in the original plan were as follows (Figures 4 and 5):

a. Navigation lock with clear chamber dimensions of 110 by 600 ft located along the right bank of the bypass canal. The lock was provided with a 621-ft-long ported upper guard wall, a 538-ft-long lower guide wall, and a short wing wall on the upper end of the land-side lock wall. The upper guard wall had 16 ports, each 20 ft wide with top ports at el 178.0. The tops of lock walls were at el 200.0.

b. A 400-ft-long gated spillway containing six 60-ft-wide tainter gates with gate sills at el 165.0 to the left of the lock. The spillway was connected to the lock with a 162-ft-long nonoverflow section and to the fill on the left overbank with a 127-ft-long nonoverflow section. The tops of the nonoverflow sections were at el 200.0.

c. The channel upstream of the approach to the lock and dam was excavated to a bottom width of 300 ft at el 177.0 and to el 165.0 and 160.0 in the approach to the spillway. The area between the upper guard wall and the right bank of the approach channel was excavated to a bottom elevation of 160.0.

d. The channel downstream of the dam and the lower lock approach was excavated to a bottom elevation of 150.0 with minimum bottom width of 300 ft.

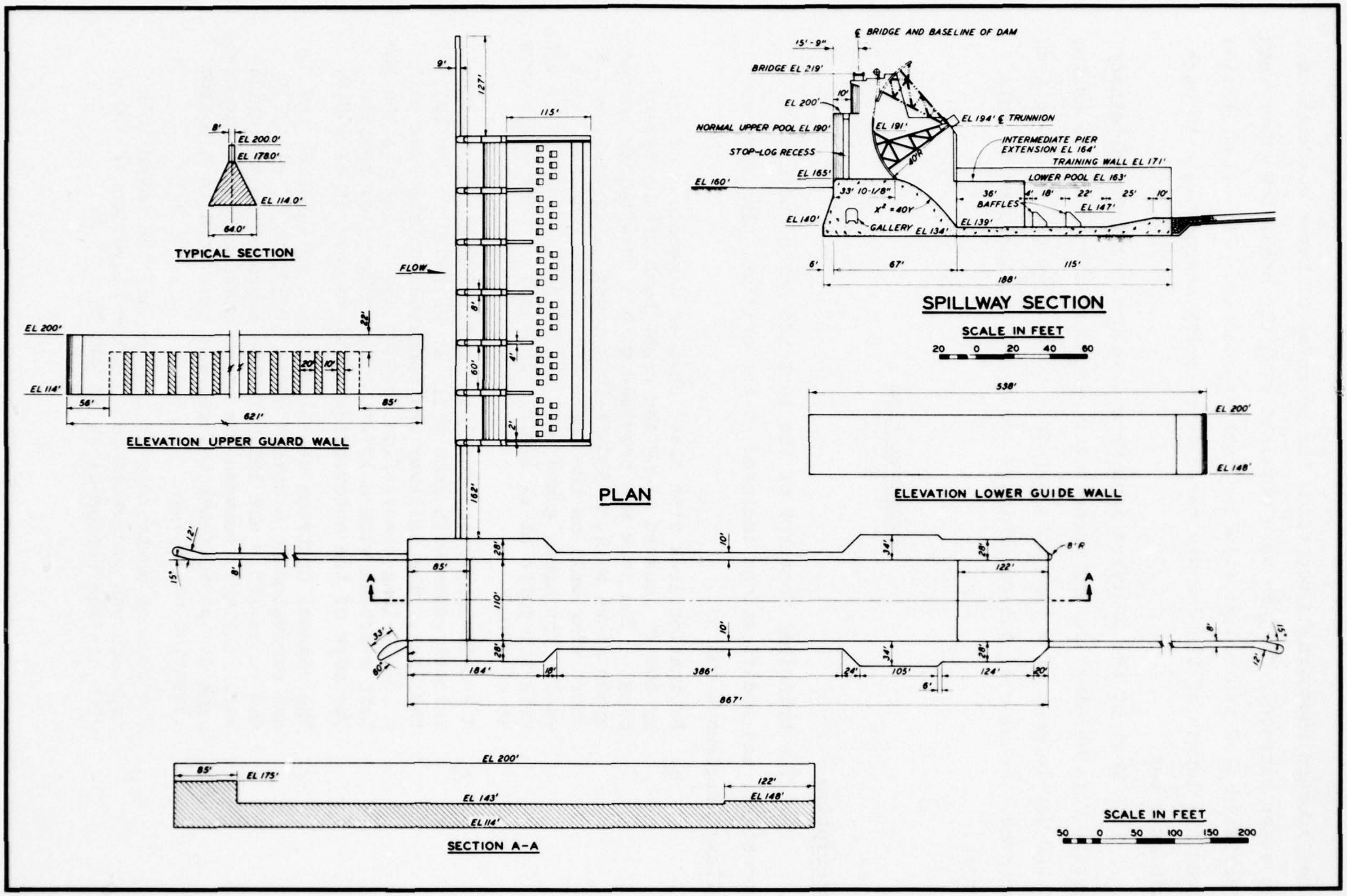


Figure 4. General plan and sections

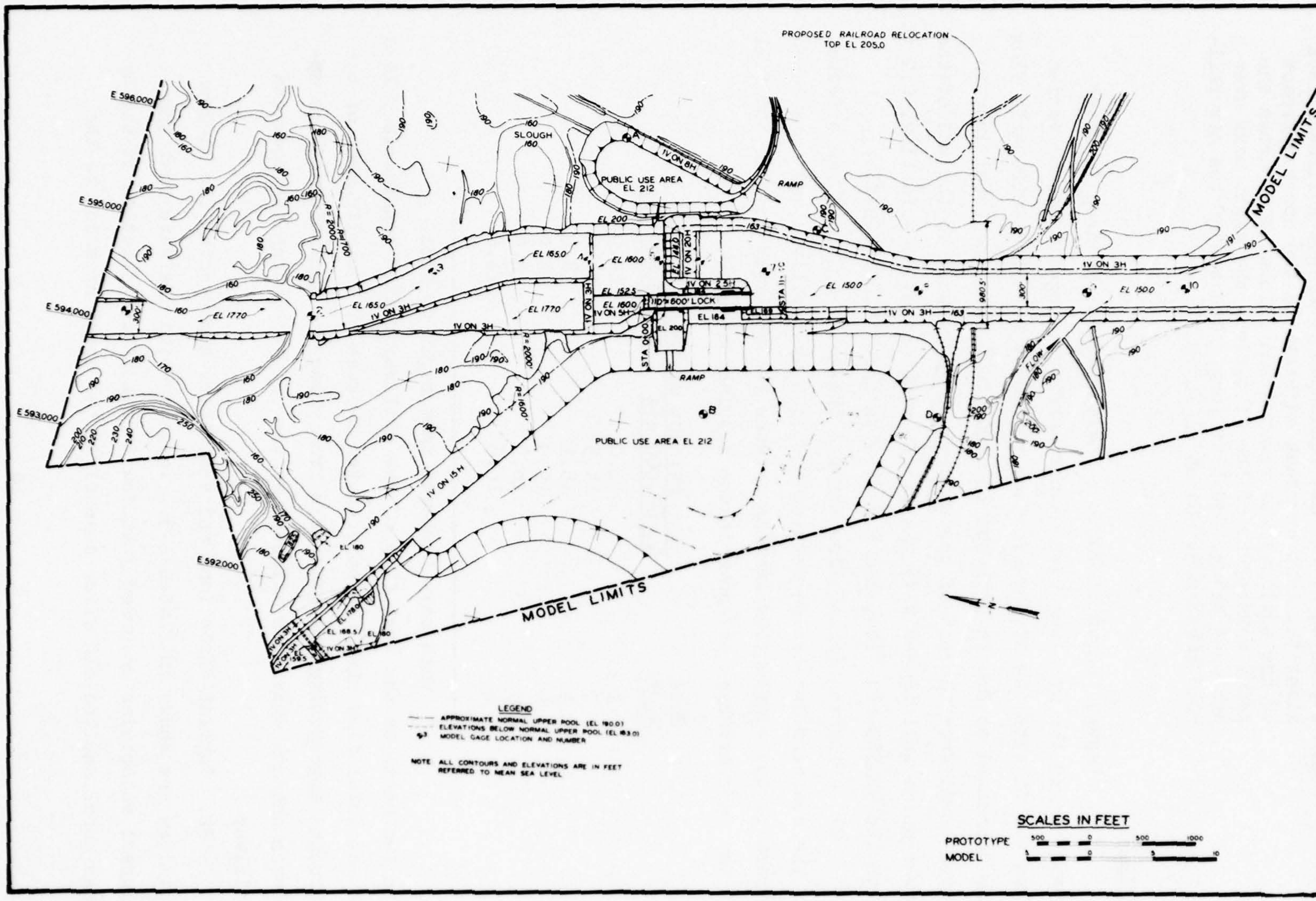


Figure 5. Original plan

e. A portion of the St. Louis-San Francisco Railroad track along the left overbank adjacent to the upper approach to the spillway was removed and relocated to cross the canal downstream of the fill along the right bank over a proposed bridge 980.5 ft long. The top of the new railroad embankment was at el 205.0.

Results

20. Results shown in Table 1 indicate that the drop in water level across the spillway with open riverflows (gages 5 and 6) varied from 0.3 ft with the 67,000-cfs flow to 0.6 ft with the 90,000-cfs flow and decreased to 0.4 ft with the 150,000-cfs flow. The total drop in water level from the end of the upper lock guard wall to the end of the lower guide wall (gages 4-7) was 0.4 ft with the 67,000-cfs flow, 0.9 ft with the 90,000-cfs flow, and 0.5 ft with the 150,000-cfs flow.

21. Distribution of flow through the gated spillway was affected by the nonoverflow section between the lock and spillway and to a lesser extent by the nonoverflow section between the spillway and the landfill on the left overbank as shown in the tabulation below:

Gate Bay*	Percent of Total Flow Q, 67,000 cfs	Percent of Total Flow Q, 90,000 cfs
1	13.0	12.9
2	14.5	14.6
3	18.1	18.0
4	19.0	18.9
5	18.8	18.8
6	16.6	16.8

* Gate bays numbered from right to left.

The two gates on the lock side of the spillway passed considerably less of the total flow than the other gates because of the alignment of the currents approaching the gate bays from along the lock side of the approach channel which was affected by the offset between the lock and spillway.

22. Current directions and velocities approaching the lock and spillway are shown in Plates 1-3. These results indicate that the highest velocities occurred just downstream of the junction of the bypass canal and the old river channel in the upper approach to the

structures. Velocities in this reach varied from about 6.7 fps with the 30,000-cfs flow to more than 14 fps with the 67,000-cfs flow. Maximum velocities with the 90,000-cfs flow were a little less than 10 fps. Velocities decreased downstream toward the structure as the width of the excavated channel increased. The high-velocity currents remained along the right side of the channel approaching the spillway and did not follow the alignment of the left bank transition. Downstream of the spillway, velocities were considerably lower than those indicated above and currents were generally parallel to the bank lines. Maximum velocities in the channel downstrean of the lock were about 8.0 fps measured with the 90,000-cfs flow. Clockwise eddies formed along the lower guide wall, particularly with the higher flows, and crosscurrents developed downstream of the eddies by flow moving from the spillway toward the right bank.

23. Navigation conditions in the upper approach were affected by the high-velocity currents a short distance upstream of the lock and by currents moving from the lock approach toward the spillway. Downbound tows would experience considerable difficulty in approaching the lock and be in danger of losing control even when attempting to flank toward the approach, particularly during the higher flows. Upbound tows would have to leave the lock from along the right bank and have sufficient power to overcome the high-velocity currents and maintain adequate steerage.

24. No serious navigation difficulties were indicated in the lower approach with the low flow. During the higher flows, navigation would be affected by the eddy currents and currents moving toward the right bank across the approach to the lock. Downbound tows leaving the lock would tend to be moved against the right bank and upbound tows would have to approach the lower guide wall from along the left bank to avoid the effects of the currents moving toward the right bank. Upbound tows would experience some difficulties in landing along the guide wall because of the effects of the eddy currents which would tend to move the head of the tow away from the wall.

Plan A

Description

25. Plan A was the same as the original plan except for modifications designed to improve navigation conditions in the upper lock approach. The plan was designed to reduce the velocities of the currents in the lock approach and reduce or eliminate the crosscurrents by increasing flow through the ports in the upper guard wall. The principal features of this plan (Figure 6) were as follows:

- a. The width of the bypass canal downstream of the Tombigbee River crossing was increased from 300 to 500 ft. The added width had a bottom elevation of 165.0.
- b. The bottom elevation of the approach to the lock was lowered 5 ft to el 172.0 on a line forming an extension of the upper guard wall and curving back toward the right bank about 2150 ft upstream of the end of the guard wall.
- c. The bottom elevation of a portion of the channel approaching the gated spillway beginning near the end of the upper wall to about 1200 ft upstream was raised 10 ft to el 175.0.

Results

26. Water-surface elevations with plan A were increased about 0.2 ft upstream of the crossing of the Tombigbee River channel (gage 1) and as much as 0.8 ft just downstream (Table 2). The greatest change occurred with the 67,000-cfs flow caused by the raising of the bottom of the approach to the spillway. The maximum increase with the 90,000-cfs flow was about 0.3 ft. The drop in water level across the spillway (gages 5 and 6) varied from 0.4 to 0.8 ft with the open riverflows and from 0.6 to 1.0 ft from the end of the upper guard wall to the end of the lower guide wall (gages 4-7).

27. Results shown in Plates 4-6 indicate a decrease in maximum velocities in the channel just downstream of the Tombigbee River crossing and a more uniform distribution of velocities farther downstream. Velocities in the approach to the lock upstream of the upper guard wall were higher with little change in the alignment of currents compared with those indicated with the original plan. Modifications upstream of

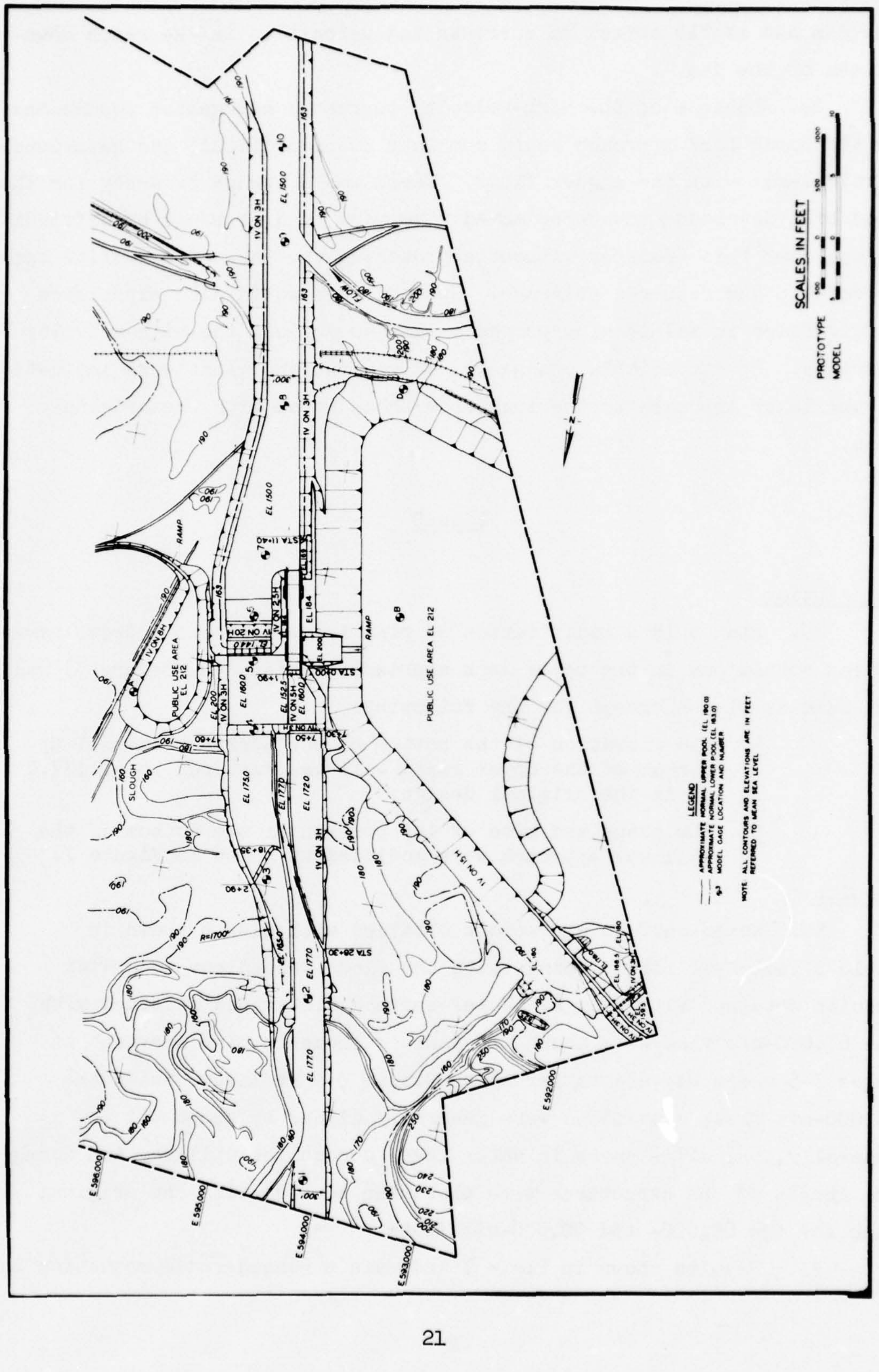


Figure 6. Plan A

the dam had little effect on currents and velocities in the reach downstream of the dam.

28. Because of the high-velocity currents, navigation conditions in the upper lock approach would continue to be difficult and hazardous, particularly with the higher flows. There was a strong tendency for the head of a downbound tow to be moved riverward, and it would be difficult to overcome this tendency without approaching the lock at excessive speed to develop the required steerage. Upbound tows would also experience difficulties in maintaining proper alignment against the high-velocity currents. No appreciable change in navigation conditions were indicated in the lower approach to the lock from those noted with the original plan.

Plan B

Description

29. Plan B is a modification of plan A developed to improve navigation conditions in the upper lock approach. This plan (Figure 7) was the same as plan A except for the following:

- a. The elevation of the bottom of the approach channel upstream of the upper guard wall was restored to el 177.0 as in the original design.
- b. The shape and size of the portion of the bottom of the spillway approach were modified as shown in Figure 7.

Results

30. Water-surface elevations obtained with plan B shown in Table 3 indicated little change with the flows tested compared with results obtained with plan A. Water-surface elevations obtained with the 67,000-cfs flow were about the same as those in plan A except at gages 3-5 where elevations were from 0.1 to 0.2 ft lower. With the 90,000-cfs flow, elevations were generally higher by about 0.1 ft. Generally, the differences in water level across the spillway and along the length of the structures were about the same as with the original plan for the 67,000- and 90,000-cfs flows.

31. Results shown in Plate 7 indicate a considerable reduction in

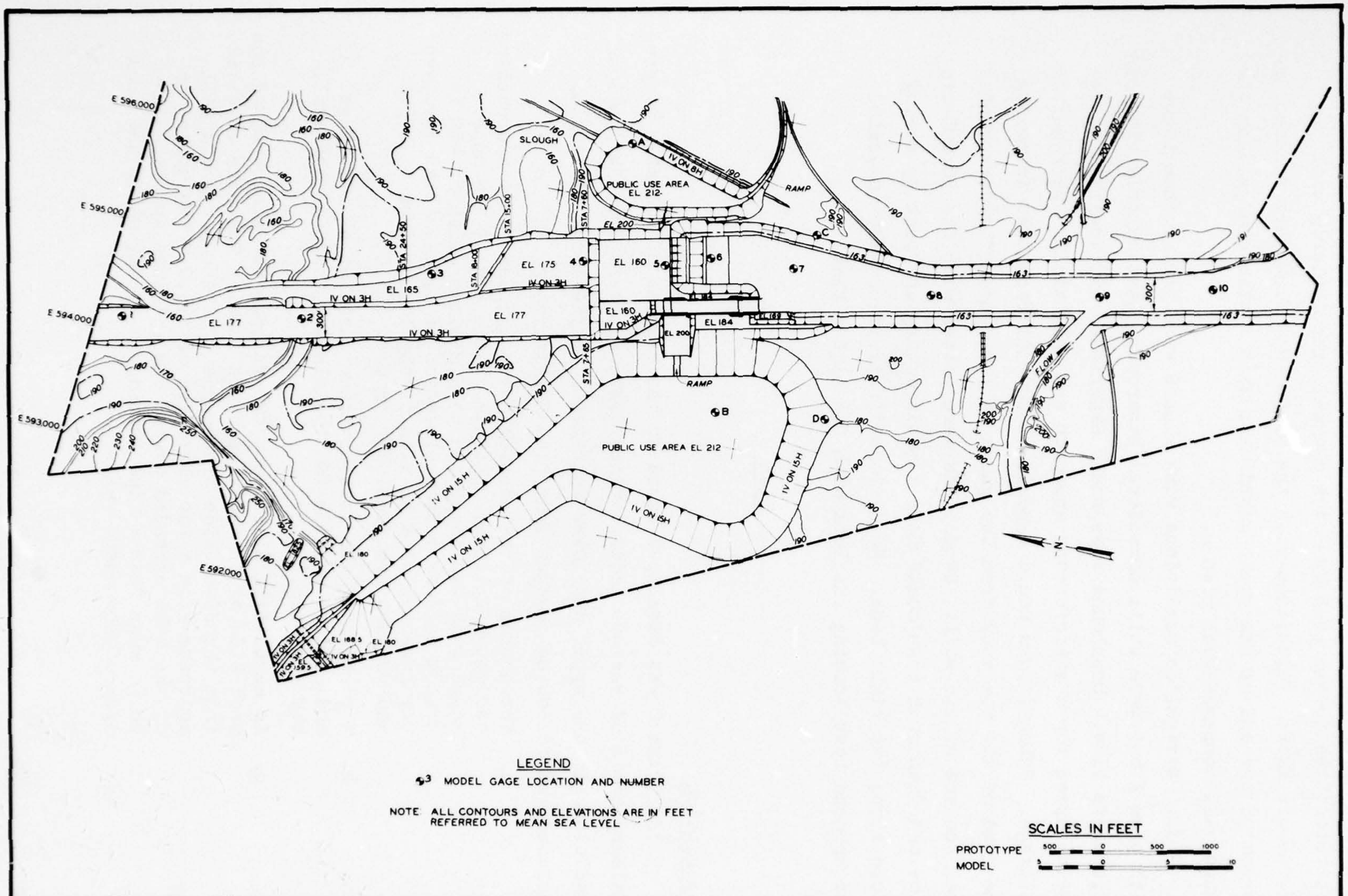


Figure 7. Plan B

the velocities in the lock approach channel, particularly with the 67,000-cfs flow. Velocities with the 90,000-cfs flow were reduced upstream of the end of the upper guard wall with little change near the guard wall compared with plan A.

32. Navigation conditions with plan B were better than those with plan A but were still considered hazardous, particularly with the 67,000-cfs flow. Downbound tows would experience difficulties in reducing speed for a satisfactory approach and maintaining the required steerage. Upbound tows would experience some difficulties in moving the head of the tow away from the guard wall because of crosscurrents near the end of the wall. Conditions were better with the 90,000-cfs flow and downbound tows could make a satisfactory approach by moving close along the right bank. No serious difficulties were indicated for upbound tows leaving the lock with the higher flow.

Plan C

Description

33. Plan C was developed based on the results of a number of preliminary tests of various modifications designed to improve navigation conditions in the upper and lower approaches to the lock. This plan included the following changes from plan B (Figure 8).

- a. The bottom of the portion of the bypass canal approaching the gated spillway upstream of the end of the upper guard wall was increased to a minimum width of 400 ft with a uniform bottom elevation of 172.0. This involved the lowering of a portion of the bottom from el 175.0 and raising the remainder from el 165.0.
- b. A portion of the lock approach canal at el 177.0 was modified to provide for the minimum width of the spillway approach.
- c. An earth-fill dike about 820 ft long was placed along the left side of the lock approach canal. The dike extended from the river side of the end of the upper guard wall upstream with a top elevation of 195.0. The upper end of the dike extended toward the spillway approach canal 90 ft away from a line forming an extension of the land side of the guard wall.

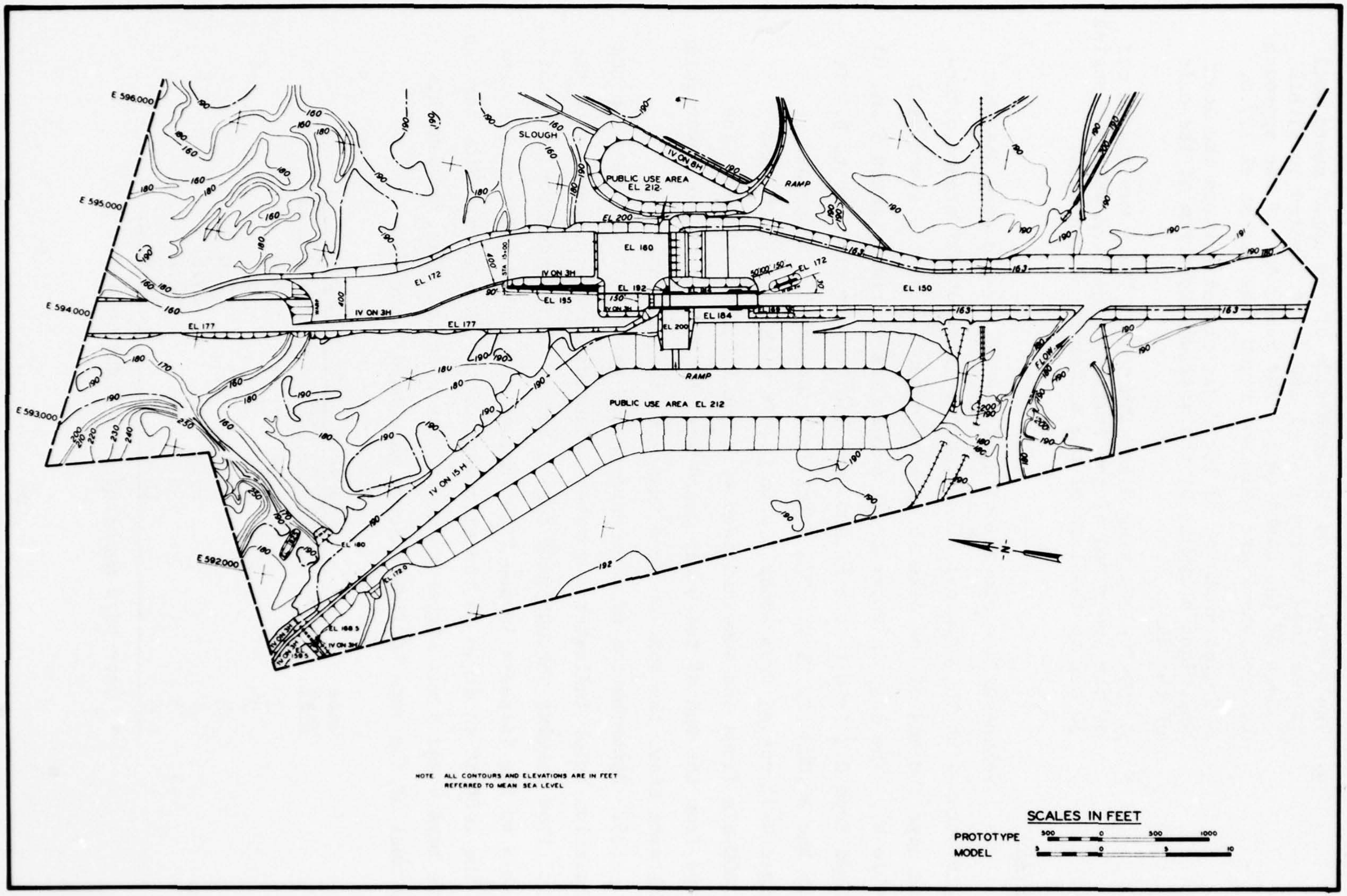


Figure 8. Plan C

_d_. The excavation on the land side of the upper guard wall in the lock approach at el 160.0 was limited to within 150 ft of the guard wall. The remainder of the approach between the guard wall and right bank was at el 177.0.

_e_. A fillet with top el 192.0 was placed between the lock and right abutment of the spillway upstream of the axis of the dam.

_f_. A 150-ft-long wing dike with top el 172.0 was placed off of the lower end of the spillway side lock wall and angled 30 deg to the left of the alignment of the wall.

Results

34. Water-surface elevations upstream of the dam were somewhat higher than with the original plan with the greatest difference occurring near the end of the dike forming an extension to the guard wall (Table 4). The drop in water level across the spillway (gages 5 and 6) ranged from 0.3 ft with the 67,000- and 150,000-cfs flows up to 0.5 ft with the 90,000-cfs flow. The total drop through the structure (gages 4-7) ranged from about 0.4 to 0.7 ft with the 67,000- and 90,000-cfs flows and somewhat less with the 150,000-cfs flow. The drops from the end of the upper guard wall to the end of the lower guide wall were about the same or less than with the original plan.

35. Distribution of flow through the gated spillway shown in the tabulation below indicates a further reduction in the proportion of the total flow passing through gate bays 1 and 2. This reduction is attributable to the increase in the flow through the ported guard wall moving to the left at an angle to the alignment of the gate bays. Flow through gate bays 4 and 5 was higher than with the original plan, compensating for most of the loss in flow through gate bays 1 and 2.

Gate	Percent of Total Flow	
Bay*	Q, 67,000 cfs	Q, 90,000 cfs
1	12.0	12.0
2	13.6	13.7
3	18.1	18.0
4	19.4	19.5
5	20.3	20.2
6	16.6	16.6

* Gate bays numbered from right to left.

36. Current directions shown in Photos 1 and 2 and Plates 8-11 indicate a considerable improvement in the alignment of currents in the lock approaches, particularly in the reach from just above the end of the dike forming an extension to the upper guard wall. Velocities in the upper reach just below the crossing of the Tombigbee River channel were considerably less than those with the original plan and higher in the approach to the upper guard wall. The dike tends to intercept more of the riverflow, increasing flow toward the upper guard wall and through the ports in the wall. Because of the alignment of the channel approaching the spillway, crosscurrents in the lock approach were not completely eliminated during the higher flows but were moved upstream past the end of the dike. The highest velocities in the upper approach to the lock were obtained with the 67,000- and 90,000-cfs flows and ranged from 5.0 to 4.9 fps. With the controlled flows, velocities were generally less than 2.0 fps with little evidence of any crosscurrents within the upper lock approach.

37. The modification in the lower lock approach reduced the size and intensity of the eddies along the lower guide wall and reduced the angle and velocity of the currents moving toward the right bank across the approach channel (Photos 1 and 2 and Plates 8-11).

38. Navigation conditions in the upper and lower approaches to the locks were considerably better than with any of the other plans and no serious difficulties were indicated with any of the flows tested. Downbound tows aligned along the right bank could drift into the upper approach to the lock from a considerable distance upstream with little control required on the tow (Photo 3). Upbound tows could move away from the upper guard wall and proceed upstream without any difficulty (Photo 4). Upbound tows could move toward the left side of the channel after passing the end of the dike and bypass a tow waiting along the right bank or moving downstream some distance upstream of the end of the dike (Photo 5). No serious difficulties were indicated in the lower approach for upbound or downbound tows. Upbound tows could approach the lower guide wall from along either side of the channel (Photo 6). For two-way traffic, conditions would be much better with downbound tows

leaving the lock and proceeding downstream along the right bank with the upbound tow moving or waiting along the left bank (Photo 7).

PART IV: COFFERDAM PLANS

39. Special tests were conducted to determine conditions that could be expected during construction of the project and variations in construction sequence and plans. Before the start of these tests, the model was modified to reproduce conditions before construction to obtain basic data for comparison with data obtained with the construction plans to be tested. All tests were conducted with the following flood flows adjusted in the model as necessary by the U. S. Army Engineer District, Mobile, to compensate for the right overbank not included in the model:

a. Discharge 90,000 cfs (25-year frequency) and tailwater el 198.0 based on existing conditions.

b. Discharge 100,000 cfs (35-year frequency) and tailwater el 198.4 and 194.9 for existing conditions and with project channel, respectively.

c. Discharge 120,000 cfs (1973 flood) and tailwater el 199.3 based on existing conditions.

d. Discharge 150,000 cfs (100-year frequency) and tailwater el 200.7 and 197.5 for existing conditions and project channel, respectively.

40. All tests were conducted assuming that no changes would occur in the channel or overbank resulting from the changes imposed during the study. During the tests with the project channel, it was assumed that the proposed channel downstream of the railroad and highway crossing was fully developed which accounts for the lower tailwater elevation.

Base Test

41. In order to determine the effects of conditions during construction, basic data were obtained for conditions before construction was simulated. These data consisted of water-surface elevations, current directions, and velocities along the adjacent overbank areas and special velocity measurements in railroad openings. These results which will be used for comparison with those obtained with various construction plans are shown in Table 5 and Plates 12-14. The total difference in water-surface elevation from the upper end of the model (gage 1) to the lower

end (gage 10) varied from about 1.0 ft with the 90,000-cfs discharge to 1.3 ft with the 120,000- and 150,000-cfs flows. Most of the differences occurred across the highway and railroad crossings (gages 8 and 9) which varied from about 0.7 ft with the 90,000- and 100,000-cfs flows to 0.9 and 1.0 ft with the 120,000- and 150,000-cfs flows, respectively. Water-surface elevations along the overbank areas to the right and left of the proposed bypass canal were generally lower than those along the alignment of the proposed canal except upstream of the railroad and highway embankments for flows up to and including the 120,000-cfs flow. With the 150,000-cfs flow, water-surface elevations were also lower just upstream of the crossings (gages D and 9L).

42. Current directions and velocities indicate velocities to be generally moderate through the reach for the proposed canal with the currents tending to move toward the opening in the railroad embankment to the right of the location for the proposed canal (Plates 12-14). The maximum velocities measured through the opening in the north branch section of the railroad along the left side of the alignment for the proposed canal were about 2.9 fps with the 120,000-cfs flow. The highest velocities ranged from 7.5 to 7.8 fps measured in the opening and downstream of the westbound section of the railroad on the right overbank with the 150,000-cfs flow.

Cofferdam with Existing Channel

Description

43. Tests were conducted with the proposed cofferdam that would include the proposed lock and dam as outlined in Plate 15. The cofferdam was tested with the existing channel downstream and with the improved channel downstream of the railroad and highway crossings. The top of the cofferdam was such that it would not be overtopped with the flows tested.

Results

44. The results of tests with the cofferdam and existing channel are shown in Table 6 and Plates 15-17. These results indicate that

stages were increased from 0.2 to 0.4 ft in the vicinity and to the right of the cofferdam (gages A-D) and along the overbank to the left (gages 3L-9L) with the 90,000-cfs flow. With the 100,000-cfs flow, the increase in water-surface elevation was slightly less and not more than 0.1 ft with the higher flows (120,000-150,000 cfs).

45. Current directions and velocities indicate no significant change in the velocity or distribution of flow resulting from the cofferdam. Velocities at all critical points were somewhat lower than those without the cofferdam. The highest velocities along the cofferdam were less than 2.0 fps with the 120,000-cfs flow.

Cofferdam with Project Channel

Description

46. Tests with the project channel assumed that the channel downstream of the railroad crossing would be completed and the tailwater elevation would be lowered accordingly.

Results

47. Water-surface elevations with the project channel were from about 1.2 to about 1.4 ft lower in the upper reach of the project (above the cofferdam) than those obtained with existing conditions before the installation of the cofferdam (Table 7). The lowering of the water-surface elevations resulted mostly from the lowering of the tailwater elevations.

48. Current directions and velocities obtained with the 150,000-cfs flow indicate little change in the alignment of currents with a general increase in current velocities particularly along the left side of the cofferdam (Plate 18). The velocity of currents approaching the cofferdam and close along the right side were generally less than those with the existing channel and as much as 1.0 fps higher close along the left side. However, maximum velocities of currents close to the cofferdam were less than 2.0 fps. Velocities near the opening through the railroad embankment downstream and to the right of the cofferdam were as much as 8.0 fps.

Cofferdam with Landfills

Description

49. Conditions for this test were the same as those in the previous test except that the landfills on the right and left banks forming the public use areas were in place with the cofferdam. A direct comparison of the effects of the landfills was obtained by conducting the tests with and without the fills and no adjustments in discharge or tailwater elevations.

Results

50. Water-surface elevations shown in Table 7 indicate that with the landfills, stages upstream of the cofferdam and along the left overbank were increased from 1.8 to 2.0 ft with the 100,000-cfs flow and from 1.5 to 1.9 ft with the 150,000-cfs flow. The tailwater elevations downstream of the railroad crossing were also raised about 0.6 to 0.8 ft with flows tested.

51. Current directions and velocities shown in Plates 19 and 20 demonstrate the effects of the fills on currents moving toward the openings in the embankments of the north-south section of the railroad. The highest spot velocities were measured through the first three openings upstream of the fill along the left overbank and ranged from about 3.5 to 3.7 fps. Floats indicated higher velocities with the 150,000-cfs flow, ranging up to about 4.5 fps.

PART V: RAILROAD RELOCATION PLANS

52. Tests were conducted to determine the effects of various plans for the relocation of the railroad embankments along the left overbank on water-surface elevations and local velocities with the proposed plan for the lock, dam, and approach channels. These tests were conducted only with the 150,000-cfs flow from the Tombigbee River upstream of the structure.

Base Test

53. In order to determine the effect of changes, a test was made to obtain data that could be used as a basis for comparison. Conditions in the model for this test were the same as the original plan except that the railroads and highway embankments were the same as those existing. The top of the east-west railroad embankments for a distance of 4200 ft east of the proposed canal center line was at el 201.0 and from that point east to the limits of the model, the grade sloped from el 201.0 to 198.0. The top of the north-south section of railroad located along the left overbank upstream of the dam was at el 201.0. The crown of the east-west highway (U. S. 45) along the left overbank was at about el 200.0. The openings in the embankments across the proposed canal downstream of the dam was 980.5 ft, the same as the original plan. Water-surface elevations obtained with this test are included in Table 8.

First Relocation Plan

Description

54. The first relocation plan involved the following changes (Plate 21):

- a. The north-south section of the railroad was relocated about 1.3 miles to the left of the canal center line with top of embankments at el 205.0.

b. The relocated section of the railroad was connected to the city of Aberdeen on the right overbank by an east-west spur line crossing the navigation canal with an opening of 1321 ft about 2800 ft downstream of the axis of the dam. Two openings of 200 and 800 ft were provided on the left overbank 3250 and 4950 ft east of the canal center line, respectively, with top of embankments at el 205.0.

c. Openings for the existing railroad and highway across the canal were at least 1321 ft. All other relief or bridge openings in the existing railroad and highway embankments on the left overbank downstream of the east-west spur were unchanged, except that the openings through the railroad and highway downstream of the 200-ft opening in the spur were increased to 650 ft each.

Results

55. Water-surface elevations with this plan were about 0.2 ft lower near the upper end of the model and about 0.1 ft lower below the dam than with the original plan (Table 8). Downstream of the spur line water-surface elevations were about the same in the canal and about 0.6 ft higher along the left overbank (gage 9L). Velocity measurements in the openings in the spur line are shown in Plate 21 (details A and B). These measurements indicate velocities near the bottom of the openings ranging from about 4.1 fps near the abutments of the 800-ft opening (detail A) to about 5.2 fps in the 200-ft opening (detail B).

Second Relocation Plan

Description

56. The conditions for this plan were generally similar to those of the first plan except that the relocated north-south section of the railroad was moved to the east close to high ground, and the east-west spur was angled slightly to the south beginning about 1500 ft east of the canal center line (Plate 22). The second relocation was tested with variations in the openings in the embankments as follows:

a. Plan A. Openings were the same as those in the first relocation plan except that the openings in the railroad and highway embankments across the navigation canal were reduced to 980.5 ft (Plate 22).

b. Plan B. Openings were the same as those in plan A except that a 1000-ft opening was made in the existing north-south section of the railroad about 2000 ft upstream of the landfill along the left bank of the canal, and the opening in the east-west section of the existing railroad embankment below the highway was increased to 700 ft (Plate 23).

c. Plan C. Openings were the same as those in plan B except that the minimum opening in the embankments across the navigation canal was increased to 1321 ft and the 800-ft opening in the spur line on the left overbank was located 7800 ft to the east of the canal center line. All openings in the existing railroad and highway embankments were the same as those existing (Plate 24).

d. Plan D. This plan was the same as plan B except that the embankment of the existing north-south section of the railroad along the left overbank upstream of the landfill was removed (Plate 25).

57. Results.

a. Plan A. Water-surface elevations with this plan were about the same as with the first relocation plan. Gages (AL and BL) located upstream and downstream of the 800-ft opening in the spur line indicated a drop of 0.8 ft in water-surface elevations through the opening. Velocities shown in Plate 22 were higher through the openings in the spur line than with the first relocation plan, ranging up to about 5.7 fps through the 800-ft opening (detail A) to about 6.5 fps through the 200-ft opening (detail B).

b. Plan B. Water-surface elevations shown in Table 8 and velocities shown in Plate 23 indicate no appreciable change from conditions obtained with plan A.

c. Plan C. Water-surface elevations with this plan were generally the same as with plans A and B except for a lowering of 0.2 ft at gage 9L which can be attributed mostly to the change in the location of the 800-ft opening with respect to the location of the gage. There was only a small reduction in the maximum velocities through the openings which ranged up to about 5.4 fps in the 800-ft opening and 6.4 fps in the 200-ft opening.

d. Plan D. Removal of the north-south section of the railroad along the left bank upstream of the lock and dam caused only a slight tendency for stages to be higher than with the other plans (Table 8). The drop in water-surface elevations through the 800-ft opening (gages AL and BL) was about 0.9 ft compared with 0.8 ft with plan A.

Velocities through the openings in the railroad embankment were somewhat higher than those with plan C with little change in the maximum velocities (Plate 25).

PART VI: DISCUSSION OF RESULTS AND CONCLUSIONS

Limitation of Model Results

58. Analysis of the results of this investigation is based principally on a study of (a) the effects of various plans and modifications on water-surface elevations, current directions, and velocities, and (b) the effects of resulting currents on the behavior of the model towboat and tow. In evaluating test results, consideration should be given to the fact that small changes in direction of flow or in velocities are not necessarily changes produced by a modification in plan since several floats introduced at the same point may follow a different path and move at slightly different velocities because of pulsating currents and eddies. Current directions and velocities shown in the plates were obtained with floats submerged to a depth of a loaded barge (9 ft prototype) and are indicative of the currents that would affect the behavior of tows.

59. The small scale of the model made it difficult to reproduce accurately the hydraulic characteristics of the prototype structures or to measure water-surface elevations within an accuracy greater than ±0.1 ft prototype. Also, the model limits did not include all of the floodway areas covered by the higher flows. The model was of the fixed-bed type and was not designed to simulate the movement of sediment in the prototype; therefore changes in channel configurations and slopes resulting from changes in the channel bed and banks that might be caused by the structure or changes in flow conditions could not be developed naturally.

Summary of Results and Conclusions

60. The principal results and conclusions developed during this investigation are outlined as follows:

- a. Navigation conditions with the original plan would be difficult and hazardous during the higher flows, particularly for downbound tows approaching the lock, because of the high-velocity currents and currents moving from the

lock approach toward the spillway. Navigation in the lower approach would be adversely affected by the clockwise eddy forming along and downstream of the guide wall.

b. Satisfactory navigation conditions in the upper lock approach could be developed by modification of the excavation of the approaches to the lock and spillway and construction of a dike forming an extension to the upper guard wall as in plan C. Navigation conditions in the lower lock approach could be improved considerably with a wing dike off the end of the river-side lock wall (plan C).

61. Water-surface elevations with plan C were somewhat higher upstream of the dam than those with the original plan, varying from 0.1 to 0.2 ft higher with the low and intermediate flows and from 0.1 to about 0.5 ft with the higher flows.

62. Distribution of flow through the gated spillway with plan C was not as good as that with the original plan but the drops in water-surface elevations across the spillway and along the lock and lock walls were not affected appreciably.

63. Flows from Mattabby Creek into the lower lock approach were generally too small to have any serious effects on navigation and were not considered in developing current patterns and velocities affecting conditions in the approach to the lock.

64. The cofferdam proposed for the construction of the lock and dam would have little effect on water-surface elevations and velocities in the surrounding area. With the cofferdam and the completed landfills on the right and left banks of the proposed canal, water-surface elevations could be as much as 2.0 ft higher than without the landfills. With the project channel downstream, stages with the cofferdam and landfill would be only about 0.6 ft higher than with existing conditions with the 100,000-cfs flow and less with the 150,000-cfs flow.

65. Relocation of the north-south section of the railroad along the high ground to the left and a spur line normal to the navigation canal would have little effect on water-surface elevations if openings totaling at least 1000 ft are provided in the spur line along the left overbank and at least 980 ft across the canal downstream of the lock and dam.

Table 1

Water-Surface Elevations, Original Plan

Gage No.	Water-Surface Elevations, ft msl Q, cfs 30,000	Q, cfs 50,000	Q, cfs 67,000	Q, cfs 90,000	Q, cfs 150,000
1	190.7	191.5	192.4	195.2	199.3
2	190.1	190.3	190.6	194.6	198.8
3	190.1	190.2	190.3	194.2	198.8
4	190.0	190.0	190.1	193.6	198.4
5	190.0*	190.0*	190.0	193.3	198.3
6	181.7	187.1	189.7	192.7	197.9
7	181.7	187.1	189.7	192.7	197.9
8	181.7	187.1	189.7	192.7	197.8
9	181.6	187.0	189.6	192.6	197.6
10	181.6*	187.0*	189.5*	192.5*	197.5*
11	--	--	--	192.7	197.6
12	--	--	--	192.6	197.5

* Controlled elevations based on project channel.

Table 2

Water-Surface Elevations, Plan A

Gage No.	Water-Surface Elevations, ft msl Q, cfs 30,000	Q, cfs 67,000	Q, cfs 90,000
1	190.7	192.6	195.4
2	190.1	191.4	194.8
3	190.1	190.9	194.5
4	190.0	190.3	193.7
5	190.0*	190.1	193.5
6	181.7	189.7	192.7
7	181.7	189.7	192.7
8	181.7	189.7	192.7
9	181.6	189.6	192.6
10	181.6*	189.5*	192.5*

* Controlled elevations based on project channel.

Table 3

Water-Surface Elevations, Plan B

Gage No.	Water-Surface Elevations, ft msl Q, cfs 67,000	Q, cfs 90,000
1	192.6	195.5
2	191.4	194.9
3	190.8	194.6
4	190.1	193.7
5	190.0	193.4
6	189.7	192.8
7	189.7	192.8
8	189.7	192.8
9	189.6	192.7
10	189.5*	192.5*
11	--	192.8
12	--	192.7

* Controlled elevations based on project channel.

Table 4

Water-Surface Elevations, Plan C

Gage No.	Water-Surface Elevations, ft msl			
	Q, cfs 15,000	Q, cfs 67,000	Q, cfs 90,000	Q, cfs 150,000
1	190.1	192.6	195.5	199.3
2	190.0	191.5	195.0	199.0
3	190.0	190.3	194.7	198.9
4	190.0	190.1	193.6	198.5
5	190.0*	190.0	193.4	198.2
6	174.1	189.7	192.9	197.9
7	174.1	189.7	192.9	197.9
8	174.0	189.7	192.9	197.9
9	174.0	189.6	192.7	197.7
10	174.0*	189.5*	192.5*	197.5*

* Controlled elevations based on project channel.

Table 5

Water-Surface Elevations, Base Test

	Water-Surface Elevations, ft msl			
Gage No.	Q, cfs 90,000	Q, cfs 100,000	Q, cfs 120,000	Q, cfs 150,000
1	199.0	199.5	200.6	202.0
2	199.0	199.5	200.6	202.0
3	199.0	199.5	200.6	202.0
4	199.0	199.5	200.6	202.0
5	199.0	199.5	200.6	202.0
6	199.0	199.5	200.6	201.9
7	199.0	199.4	200.5	201.9
8	198.7	199.2	200.3	201.8
9	198.0	198.5	199.4	200.8
10	198.0*	198.4*	199.3*	200.7*
A	198.6	199.3	200.4	201.7
B	198.3	199.1	200.3	201.7
C	198.5	199.2	200.3	201.7
D	198.2	198.8	200.1	201.5
3L	198.5	199.1	200.3	201.5
6L	198.4	199.0	200.1	201.5
9L	198.2	198.8	199.9	201.4

NOTE: Model discharge adjusted to compensate for right overbank area not included in model.

* Controlled elevations based on existing conditions.

Table 6

Water-Surface Elevations, Cofferdam with Existing Channel

Gage No.	Water-Surface Elevations, ft msl Q, cfs 90,000	Q, cfs 100,000	Q, cfs 120,000	Q, cfs 150,000
1	199.0	199.6	200.7	202.1
2	199.0	199.6	200.7	202.1
3	199.0	199.6	200.7	202.1
4	199.0	199.6	200.7	202.1
8	198.7	199.4	200.5	201.9
9	198.0	198.5	199.4	200.8
10	198.0*	198.4*	199.3*	200.7*
A	198.8	199.5	200.5	201.7
B	198.7	199.3	200.4	201.7
C	198.8	199.3	200.4	201.7
D	198.5	199.1	200.2	201.4
3L	198.8	199.3	200.4	201.5
6L	198.8	199.3	200.2	201.4
9L	198.6	199.0	200.0	201.3

NOTE: Gages 5-7 inside cofferdam.
* Controlled elevations based on existing channel downstream.

Table 7

Water-Surface Elevations, Cofferdam with Project Channel

Gage No.	Water-Surface Elevations, ft msl			
	Without Landfills		With Landfills	
	Q, cfs 100,000	Q, cfs 150,000	Q, cfs 100,000	Q, cfs 150,000
1	198.1	200.8	200.1	202.3
2	198.1	200.8	200.1	202.3
3	198.0	200.8	200.1	202.3
4	198.0	200.8	200.0	202.3
8	197.2	199.9	--	--
9	194.7	197.6	195.4	198.4
10	194.6*	197.5*	195.4**	198.3**
A	197.7	200.3	--	--
B	197.4	200.3	--	--
C	197.5	200.1	--	--
D	197.1	199.9	--	--
3L	197.5	200.1	199.4	201.8
6L	197.5	200.0	199.3	201.6
9L	197.2	199.7	199.0	201.2

NOTE: Gages 5-7 inside the cofferdam and gages A-D covered by landfills.

* Controlled elevations based on project channel.

** Control same as without landfills. Elevation shown affected by landfills.

Table 8

Water-Surface Elevations, Effects of Railroad Relocation Plans

Gage No.	Base Test	First Relocation Plan	Second Relocation Plan: Plan A	Plan B	Plan C	Plan D
	Water-Surface Elevations, ft msl					
1	199.5	199.3	199.3	199.4	199.4	199.3
2	198.9	198.7	198.7	198.7	198.7	198.8
3	198.9	198.7	198.7	198.7	198.7	198.8
4	198.5	198.4	198.5	198.4	198.4	198.4
5	198.2	198.1	198.2	198.2	198.1	198.3
6	198.0	197.9	197.9	197.9	197.9	197.9
7	198.0	197.9	197.9	197.9	197.9	197.9
8	197.9	197.9	197.9	197.9	197.9	197.8
9	197.6	197.6	197.6	197.6	197.6	197.6
10	197.5*	197.5*	197.5*	197.5*	197.5*	197.5*
11	197.6	197.8	197.8	197.8	197.7	197.6
12	197.6	197.7	197.6	197.6	197.7	197.5
3L	199.4	199.3	199.4	199.4	199.3	199.5
6L	199.0	199.0	199.0	199.0	198.9	198.9
AL**	--	--	198.6	--	--	198.6
BL**	--	--	197.8	--	--	197.7
9L	197.2	197.8	197.6	197.6	197.4	197.6

NOTE: All water-surface elevations at 150,000-cfs discharge.
* Controlled elevations based on project channel.
** Temporary gages located just upstream and downstream of the 800-ft opening through the east-west railroad spur along the left overbank.

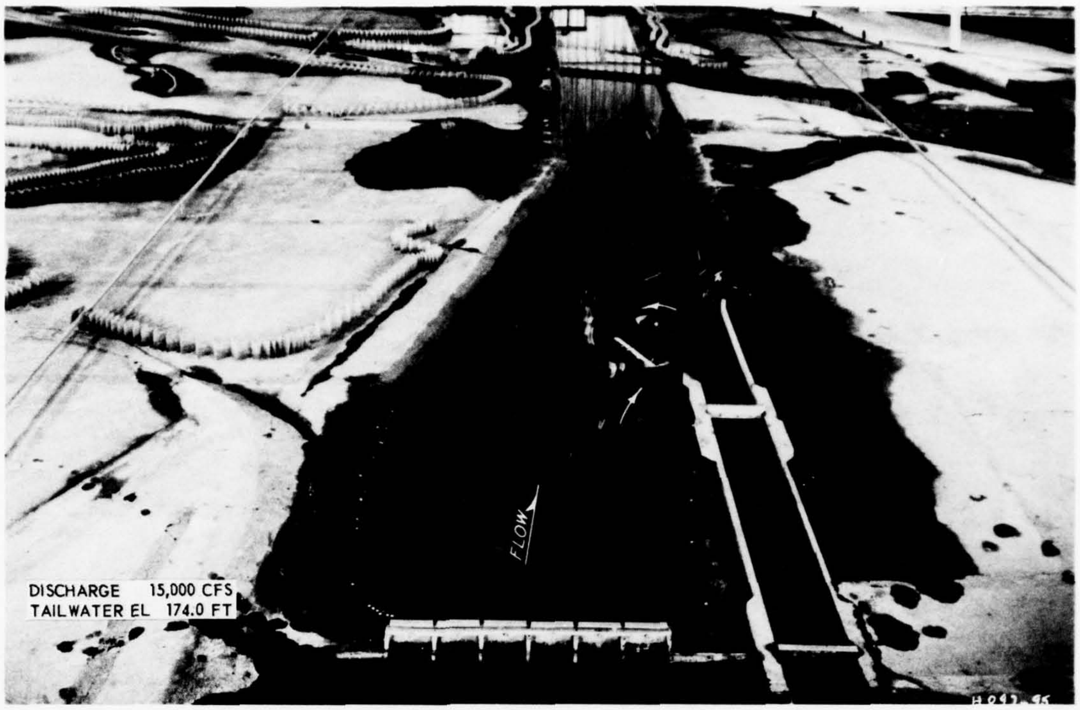


Photo 1. Plan C, surface currents downstream of gated spillway and in lower lock approach. Note effect of wing dike to left of approach

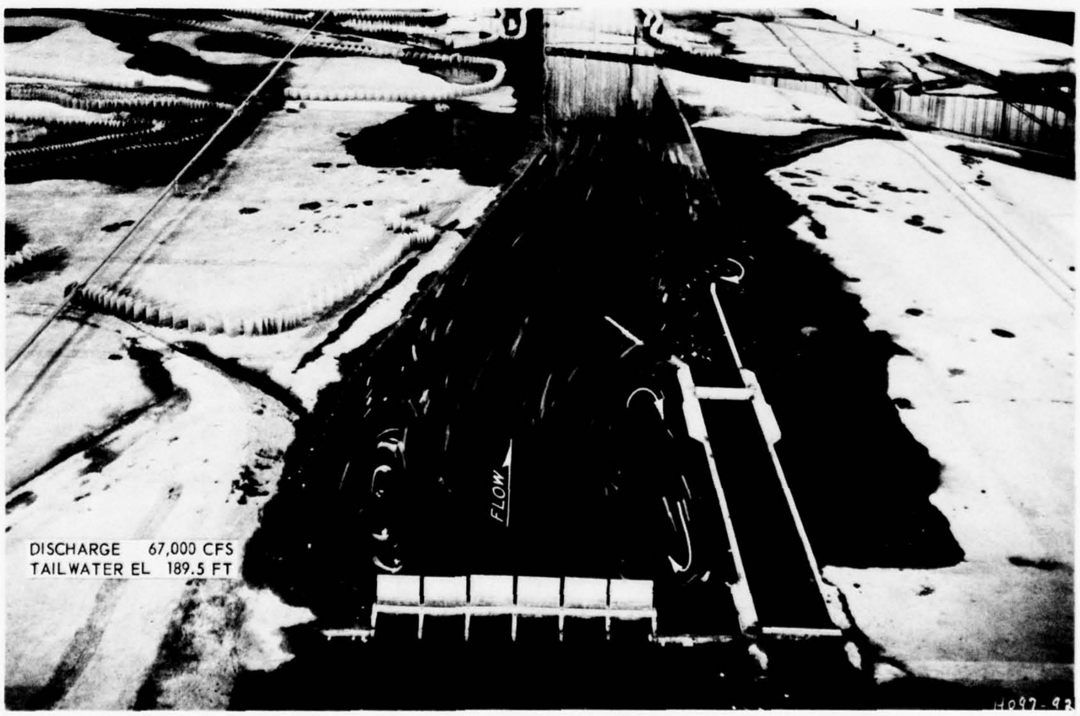


Photo 2. Plan C, surface currents through gated spillway and in lower lock approach with wing dike in place

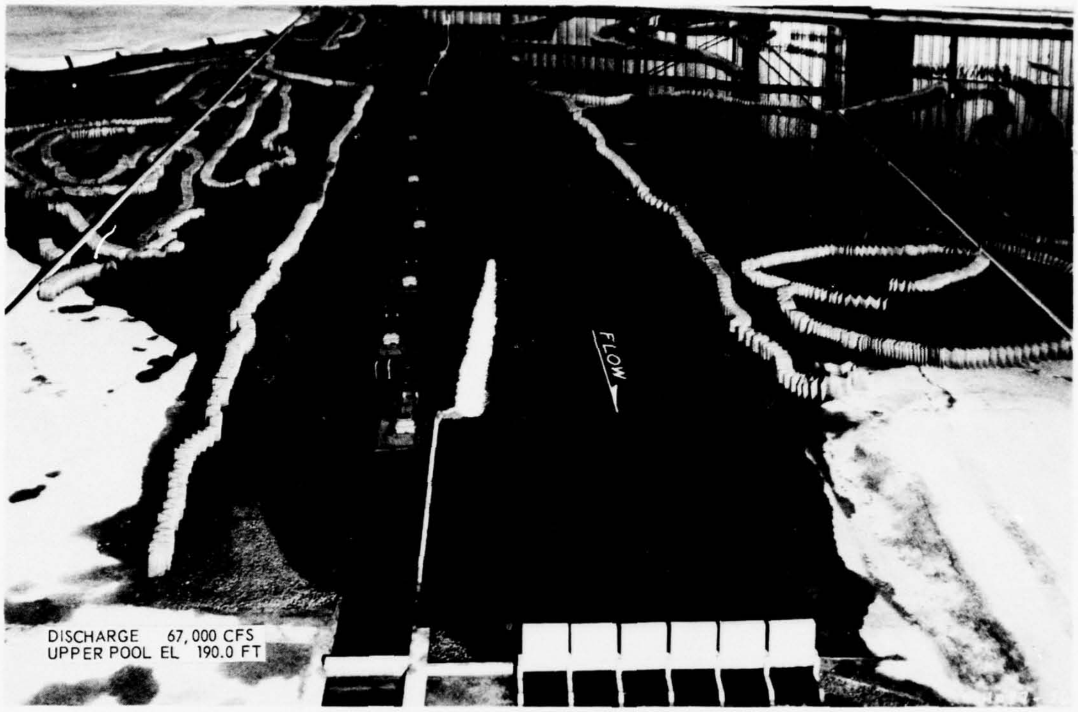


Photo 3. Plan C, path of downbound tow drifting into the lock approach from a considerable distance upstream

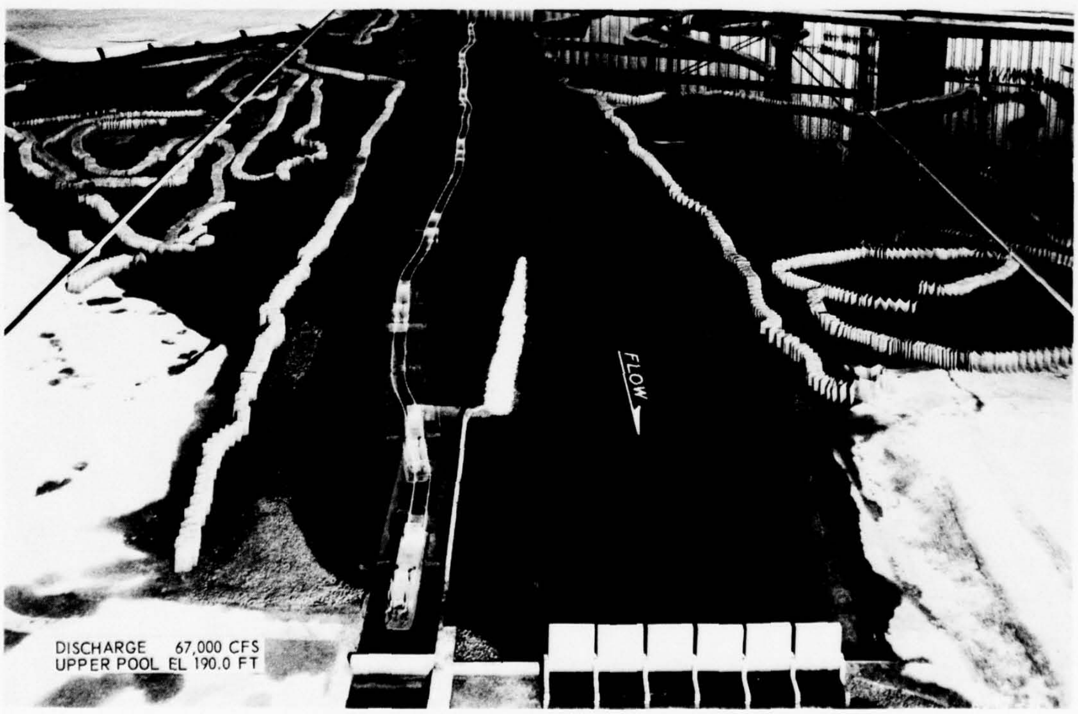


Photo 4. Plan C, path of upbound tow leaving upper guard wall and proceeding upstream along the right bank

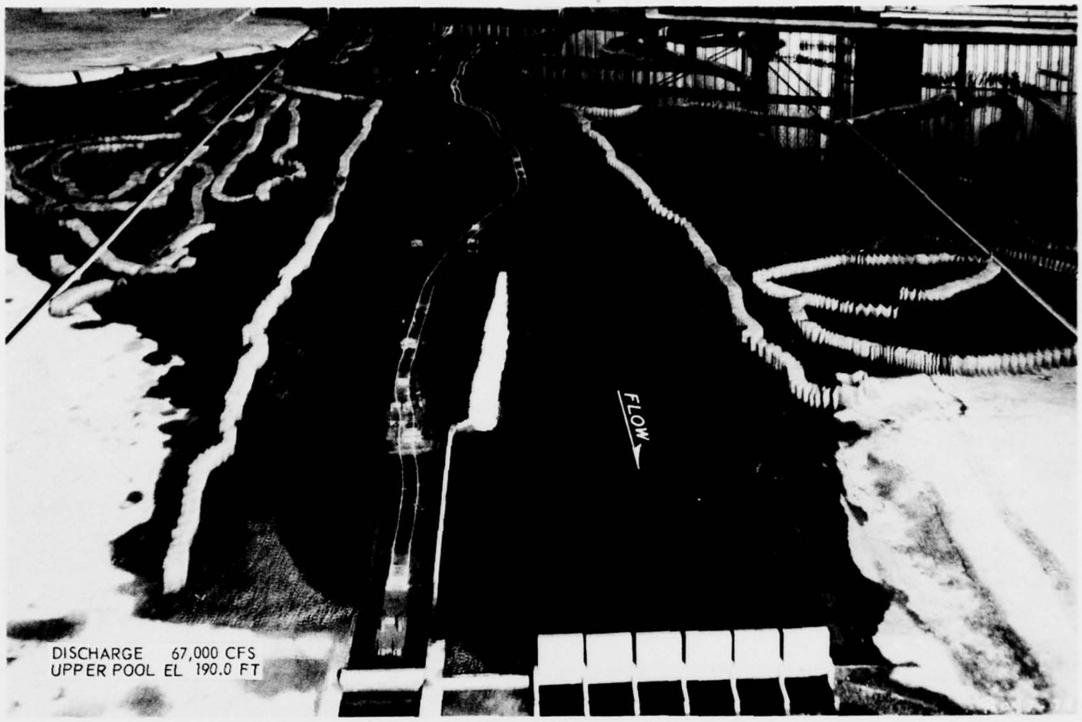


Photo 5. Plan C, path of upbound tow leaving upper lock approach and bypassing tow along the right bank

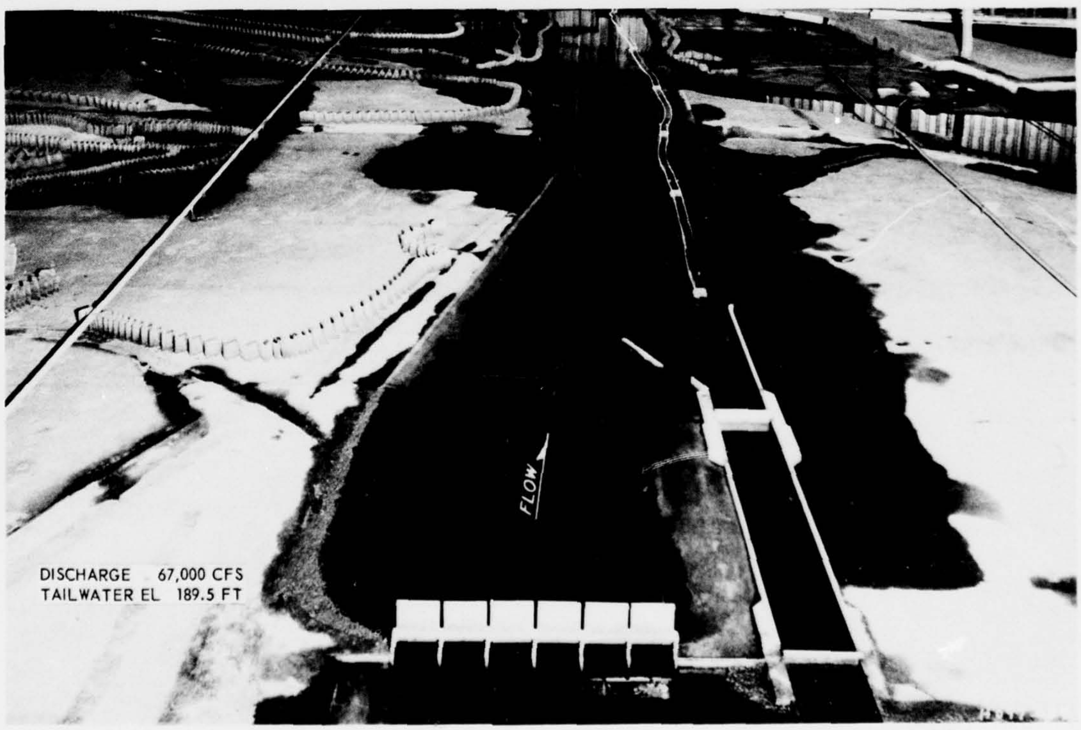


Photo 6. Plan C, path of upbound tow approaching the lock along the right bank

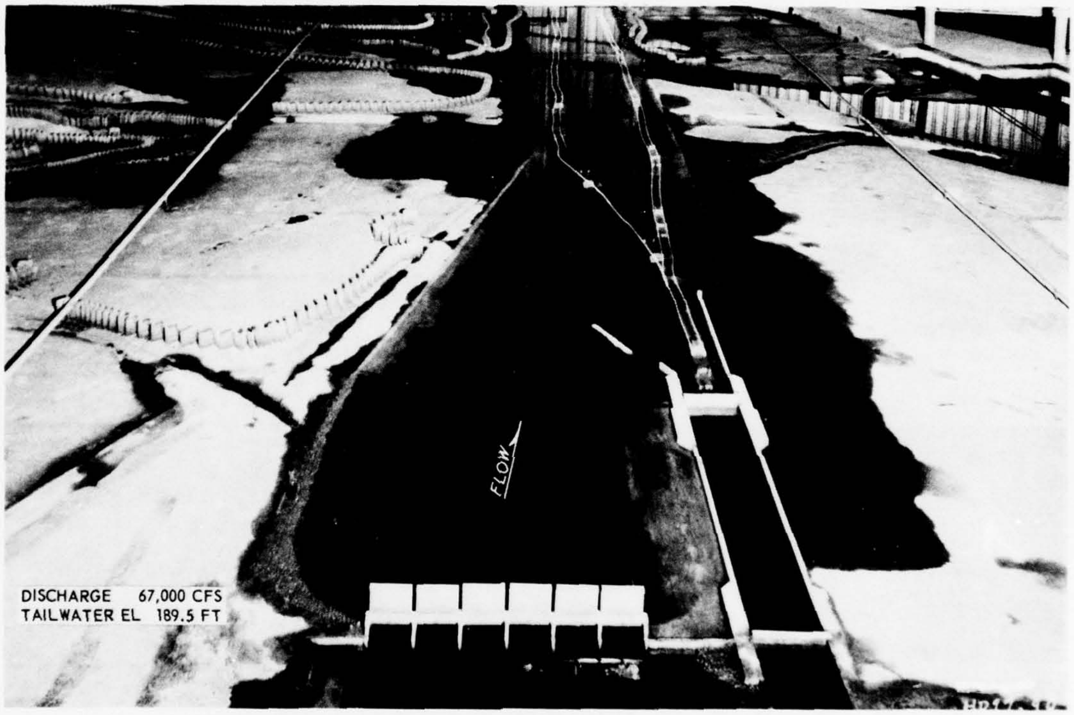


Photo 7. Plan C, path of downbound tow with upbound tow approaching along left bank

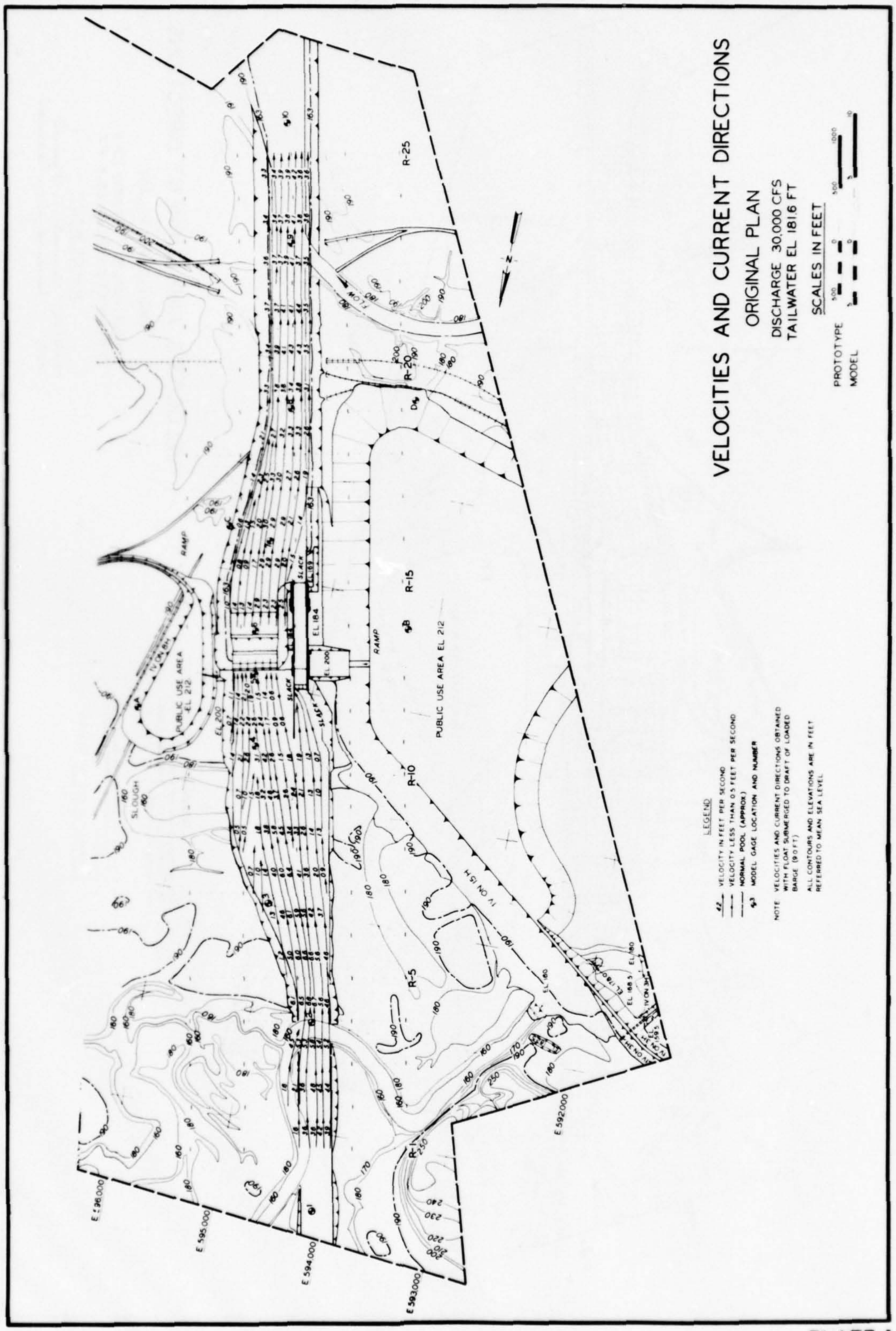

VELOCITIES AND CURRENT DIRECTIONS
ORIGINAL PLAN
DISCHARGE 30,000 CFS
TAILWATER EL 181.6 FT
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
VELOCITY IN FEET PER SECOND
VELOCITY LESS THAN 0.5 FEET PER SECOND
NORMAL POOL (APPROX)
MODEL GAGE LOCATION AND NUMBER
NOTE VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (9.0 FT)
ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL.
PUBLIC USE AREA EL 212
RAMP
SLOUGH
EL 184
SLACK
R-1
R-5
R-10
R-15
R-20
R-25
E 592,000
E 593,000
E 594,000
E 595,000
E 596,000

PLATE 1

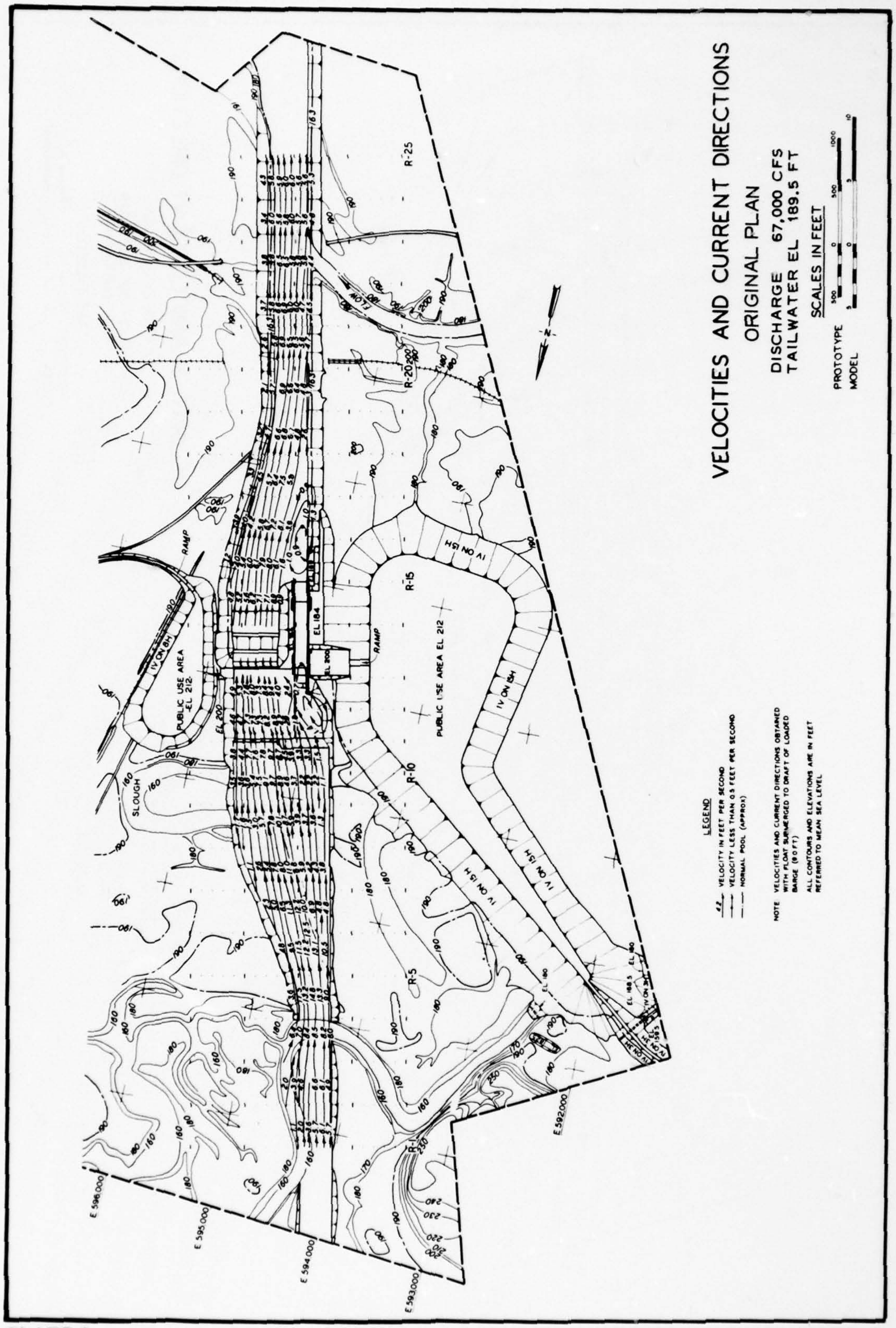

VELOCITIES AND CURRENT DIRECTIONS
ORIGINAL PLAN
DISCHARGE 67,000 CFS
TAILWATER EL 189.5 FT
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
4.2 VELOCITY IN FEET PER SECOND
VELOCITY LESS THAN 0.5 FEET PER SECOND
NORMAL POOL (APPROX)
NOTE VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (8 FT)
ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL
PUBLIC USE AREA EL 212
PUBLIC USE AREA EL 212
SLOUGH
RAMP
FLOW
N
E 596,000
E 595,000
E 594,000
E 593,000
E 592,000

PLATE 2

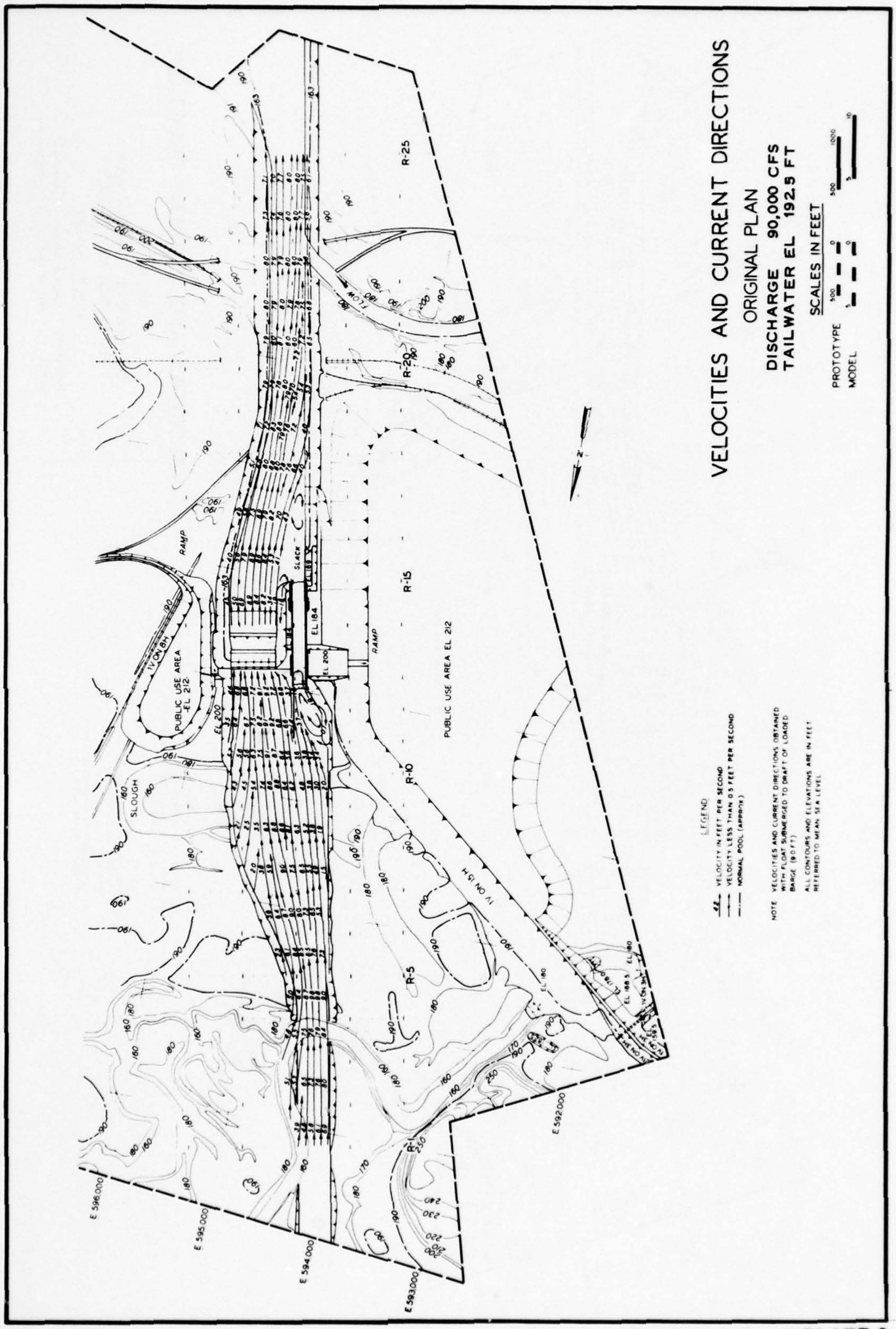
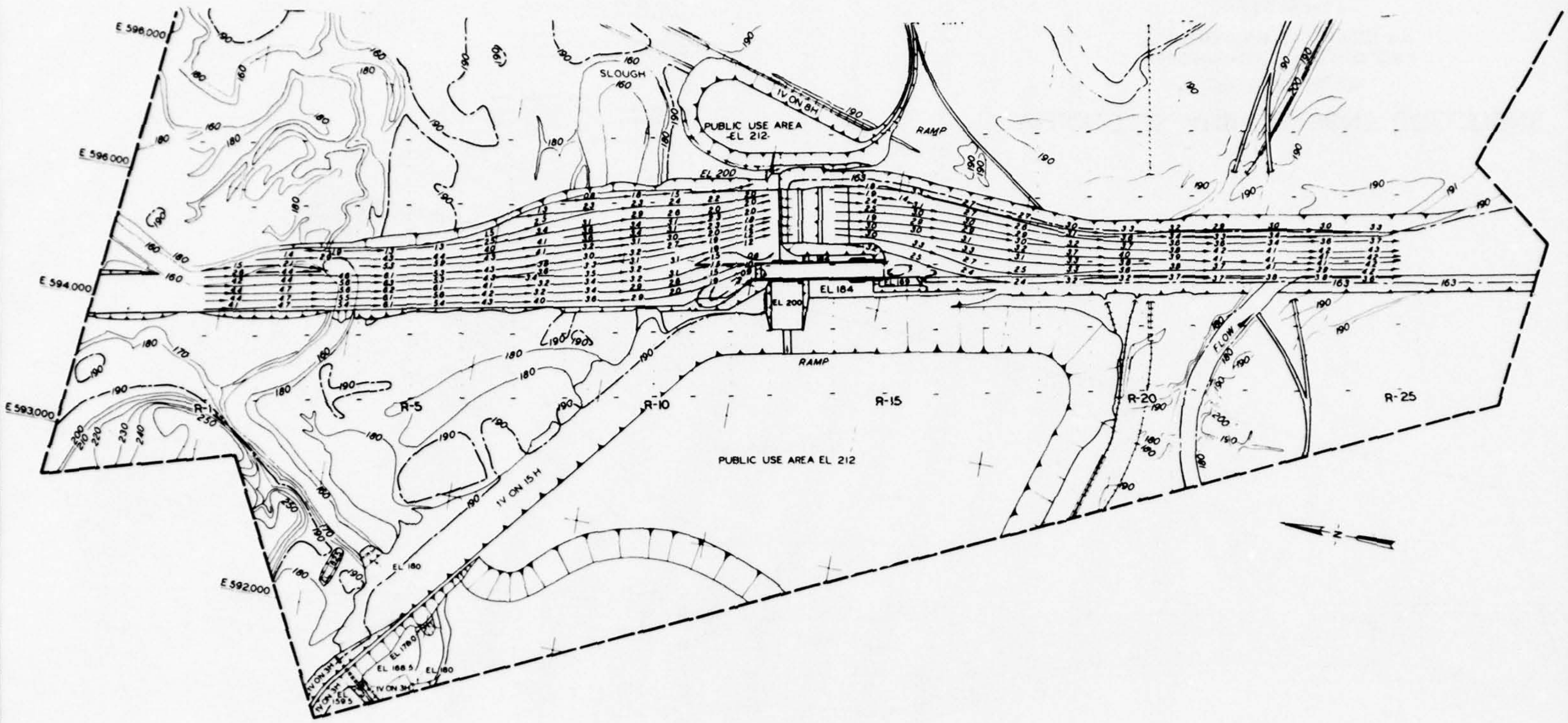

VELOCITIES AND CURRENT DIRECTIONS
ORIGINAL PLAN
DISCHARGE 90,000 CFS
TAILWATER EL 192.5 FT
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
VELOCITY IN FEET PER SECOND
VELOCITY LESS THAN 0.5 FEET PER SECOND
NORMAL POOL (APPROX)
NOTE: VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (9.0 FT)
ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL.
PUBLIC USE AREA EL 212
PUBLIC USE AREA EL 212
RAMP
RAMP
SLOUGH
SLACK
EL 184
EL 200
FLOW
R-5
R-10
R-15
R-20
R-25
E 592,000
E 593,000
E 594,000
E 595,000
E 596,000

PLATE 3



LEGEND

4.2 VELOCITY IN FEET PER SECOND

VELOCITY LESS THAN 0.5 FEET PER SECOND

NORMAL POOL (APPROX)

NOTE: VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (9.0 FT)

ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL

VELOCITIES AND CURRENT DIRECTIONS

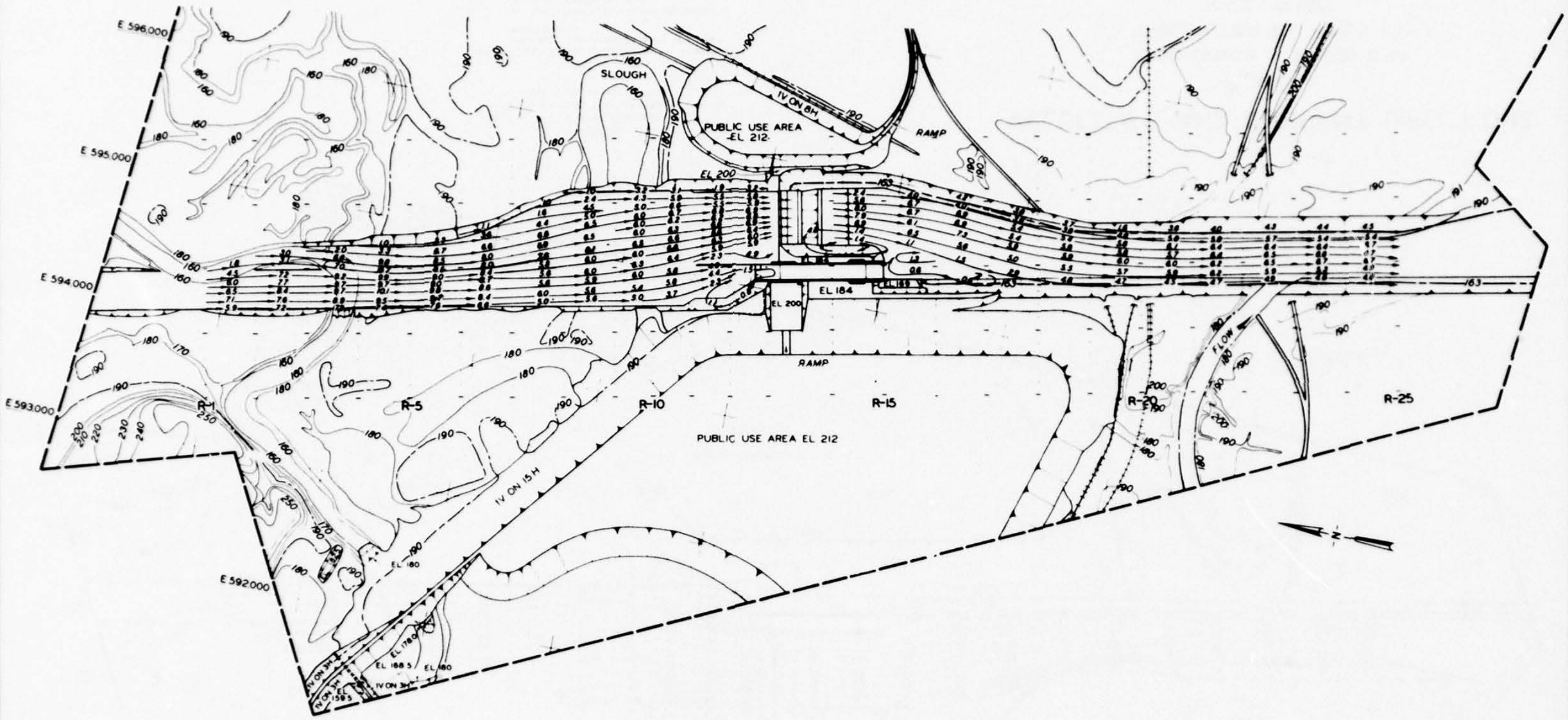
PLAN A

DISCHARGE 30,000 CFS
TAILWATER EL 181.6 FT

SCALES IN FEET

PROTOTYPE 500 0 500 1000

MODEL 5 0 5 10



LEGEND

- 4.2 VELOCITY IN FEET PER SECOND
- VELOCITY LESS THAN 0.5 FEET PER SECOND
- NORMAL POOL (APPROX)

NOTE: VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (9.0 FT)

ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL

VELOCITIES AND CURRENT DIRECTIONS

PLAN A

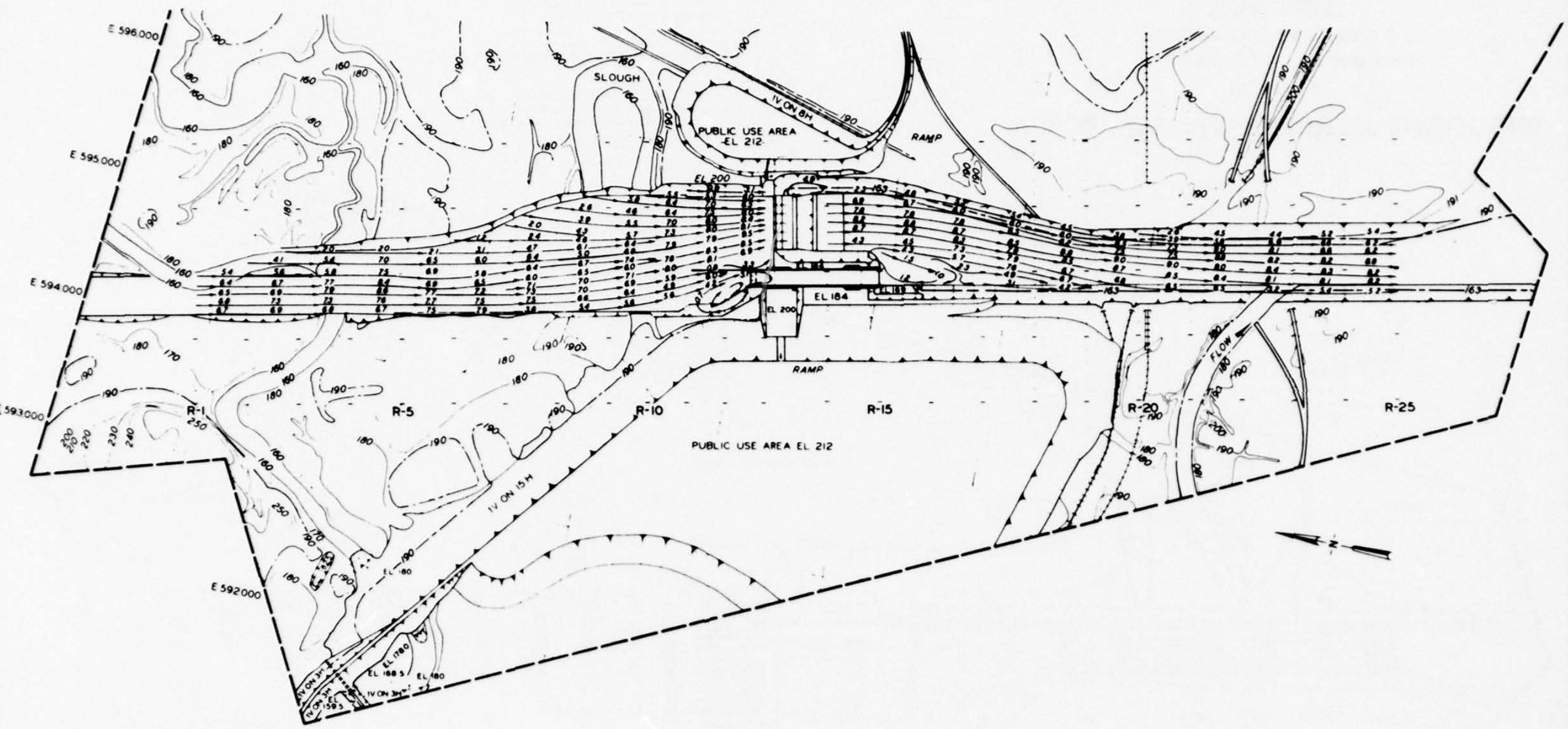
DISCHARGE 67,000 CFS

TAILWATER EL 189.5 FT

SCALES IN FEET

PROTOTYPE 500 0 500 1000

MODEL 5 0 5 10



VELOCITIES AND CURRENT DIRECTIONS

PLAN A

DISCHARGE 90,000 CFS

TAILWATER EL 192.5 FT

SCALES IN FEET

PROTOTYPE 500 0 500 1000

MODEL 5 0 5 10

LEGEND

4.2 VELOCITY IN FEET PER SECOND

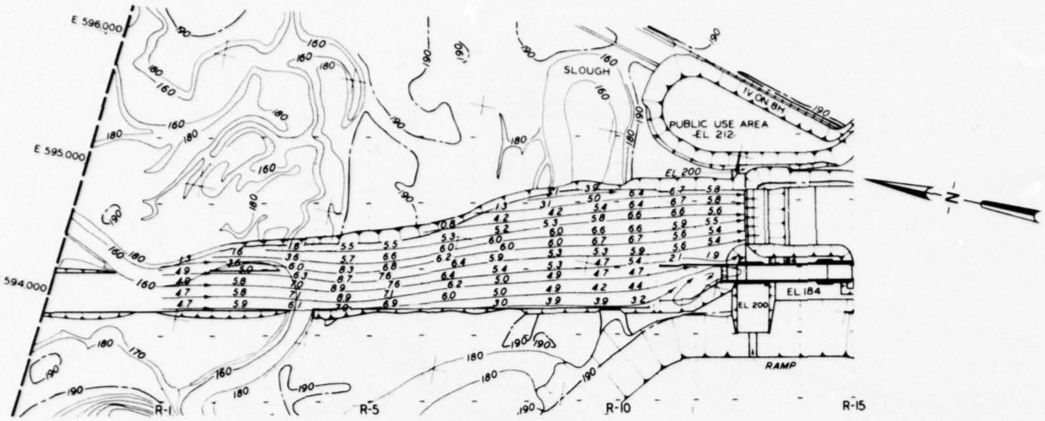
VELOCITY LESS THAN 0.5 FEET PER SECOND

NORMAL POOL (APPROX)

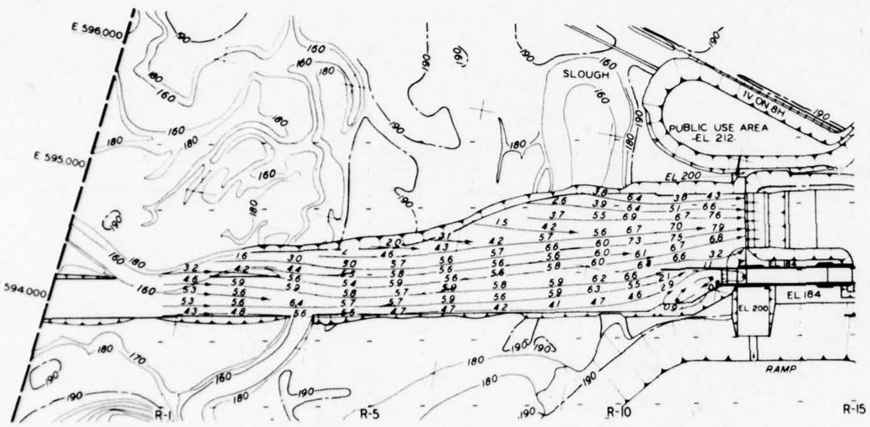
NOTE VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (9.0 FT)

ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL

PLATE 6



DISCHARGE 67,000 CFS
TAILWATER EL 189.5 FT



DISCHARGE 90,000 CFS
TAILWATER EL 192.5 FT

LEGEND

4.2 → VELOCITY IN FEET PER SECOND

→ VELOCITY LESS THAN 0.5 FEET PER SECOND

— · — NORMAL POOL (APPROX)

NOTE: VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (9.0 FT)

ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL

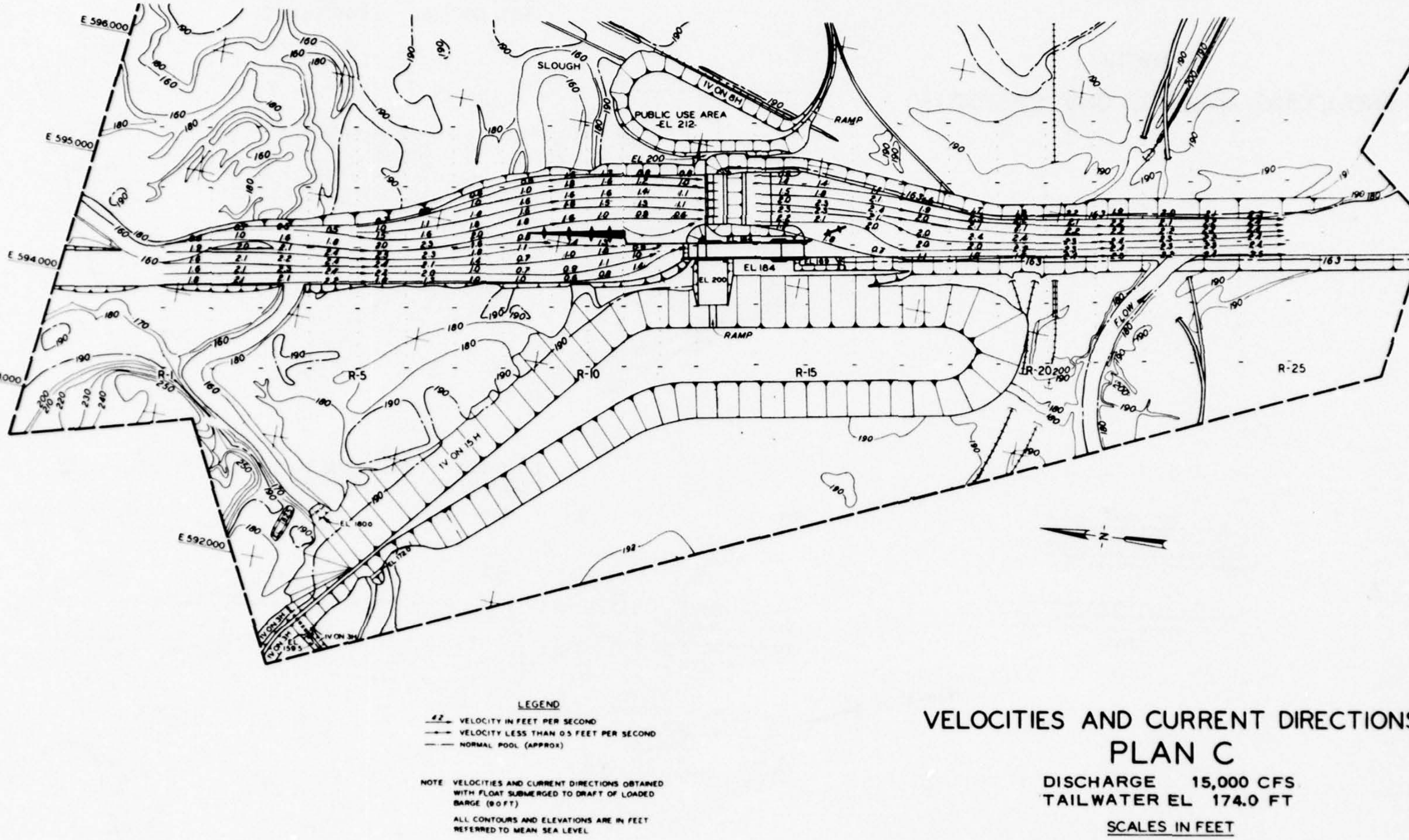
VELOCITIES AND CURRENT DIRECTIONS

PLAN B

SCALES IN FEET

PROTOTYPE 500 0 500 1000

MODEL 5 0 5 10



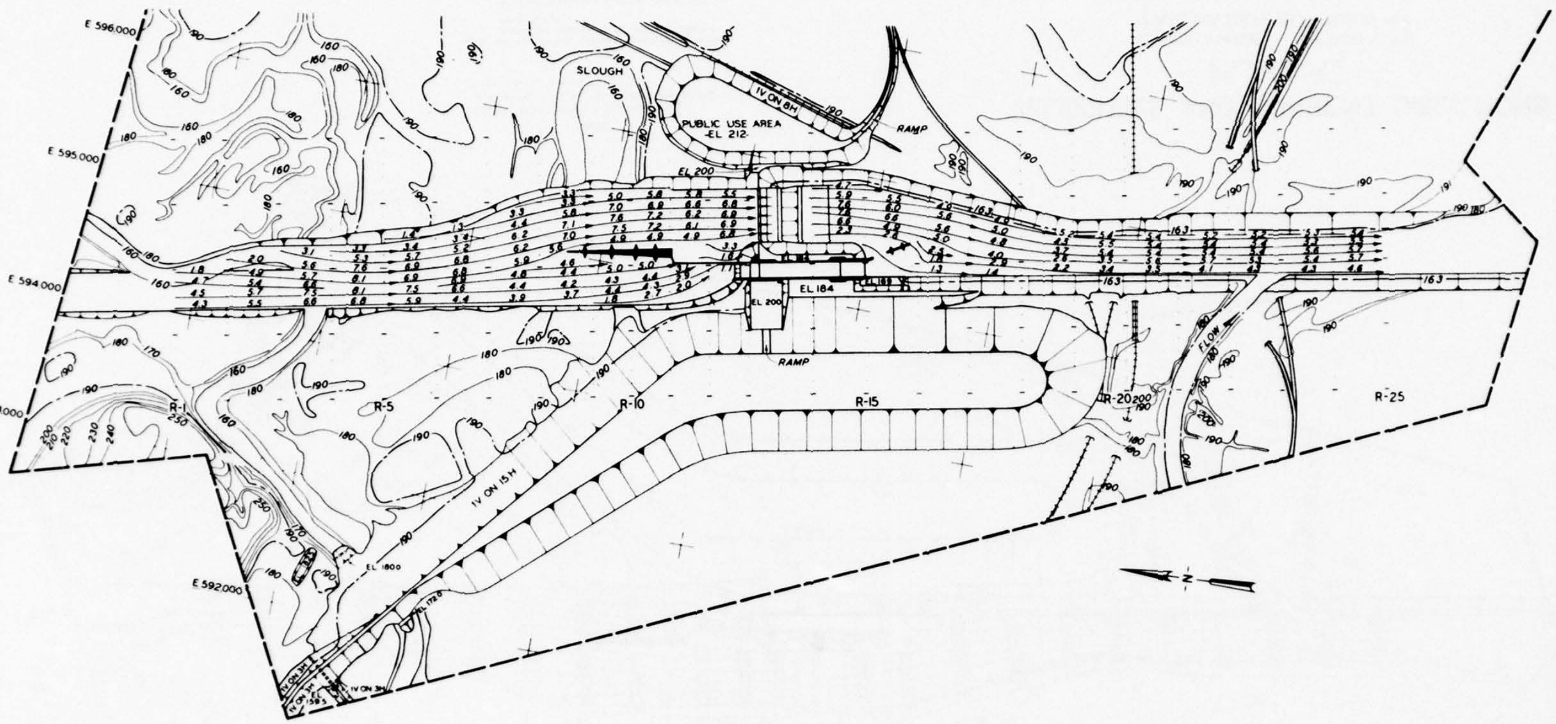
VELOCITIES AND CURRENT DIRECTIONS
PLAN C

DISCHARGE 15,000 CFS
TAILWATER EL 174.0 FT

SCALES IN FEET

PROTOTYPE 500 0 500 1000
MODEL 5 0 5 10

PLATE 8



LEGEND

4.2 → VELOCITY IN FEET PER SECOND
→ VELOCITY LESS THAN 0.5 FEET PER SECOND
— · — NORMAL POOL (APPROX)

NOTE: VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (9.0 FT)

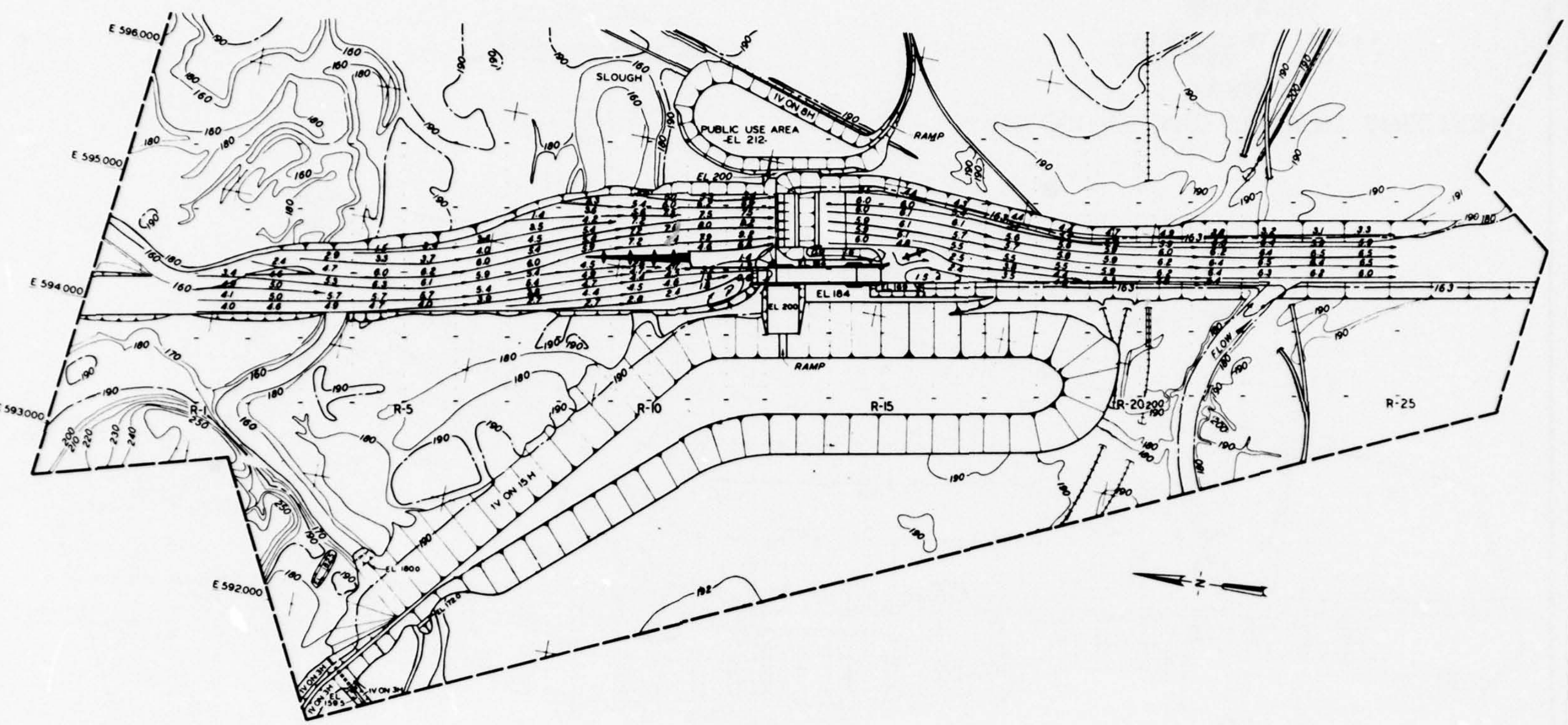
ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL

VELOCITIES AND CURRENT DIRECTIONS
PLAN C

DISCHARGE 67,000 CFS
TAILWATER EL 189.5 FT

SCALES IN FEET

PROTOTYPE 500 0 500 1000
MODEL 5 0 5 10



LEGEND

42 VELOCITY IN FEET PER SECOND
VELOCITY LESS THAN 0.5 FEET PER SECOND
NORMAL POOL (APPROX)

NOTE VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (9.0 FT)

ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL

VELOCITIES AND CURRENT DIRECTIONS
PLAN C

DISCHARGE 90,000 CFS
TAILWATER EL 192.5 FT

SCALES IN FEET

PROTOTYPE 500 0 500 1000
MODEL 5 0 5 10

PLATE 10

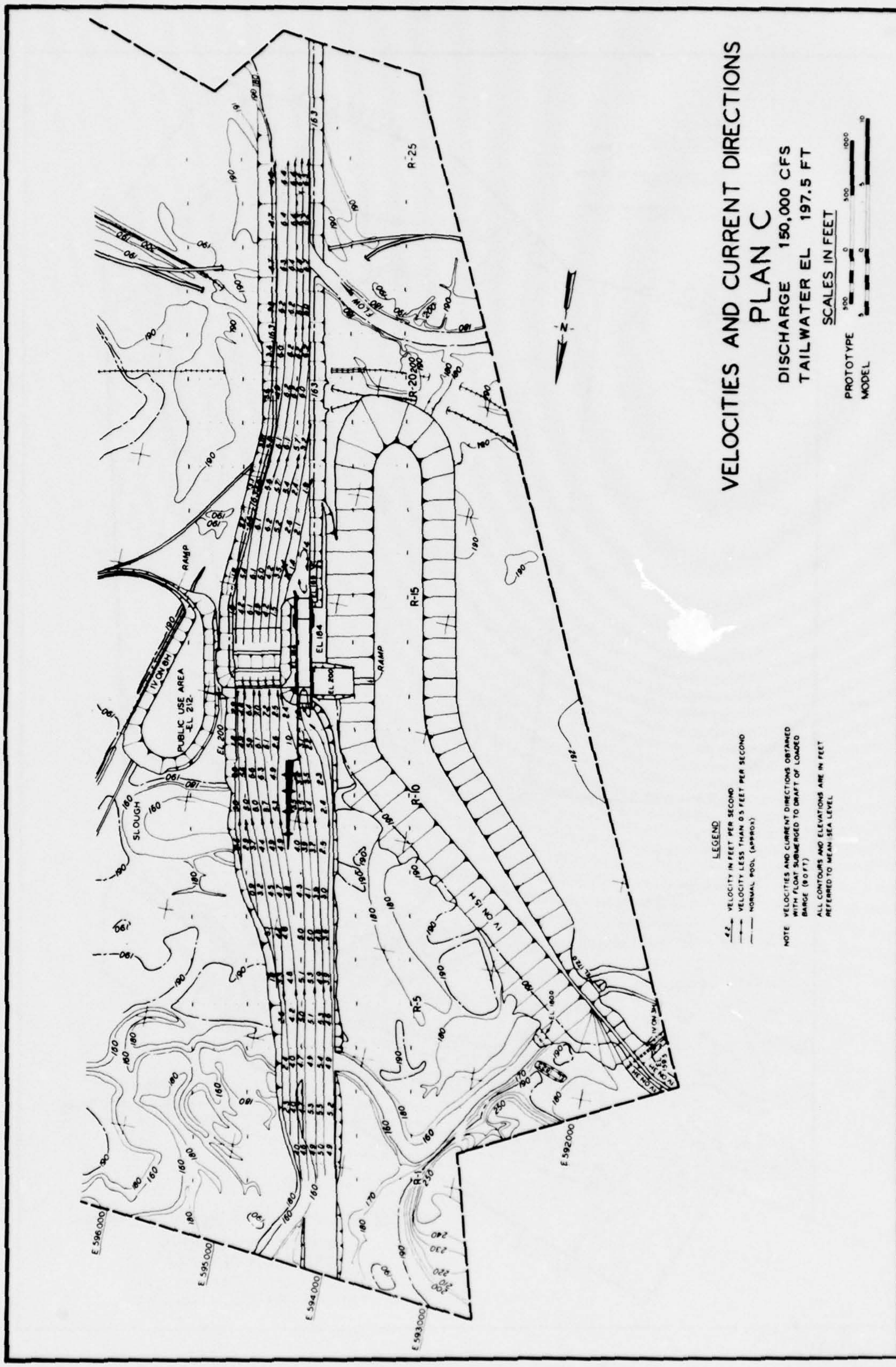

VELOCITIES AND CURRENT DIRECTIONS
PLAN C
DISCHARGE 150,000 CFS
TAILWATER EL 197.5 FT
SCALES IN FEET
PROTOTYPE
MODEL
LEGEND
VELOCITY IN FEET PER SECOND
VELOCITY LESS THAN 0.5 FEET PER SECOND
NORMAL POOL (APPROX)
NOTE VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED TO DRAFT OF LOADED BARGE (9.0 FT)
ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL
PUBLIC USE AREA
EL 212
SLOUGH
RAMP
EL 200
EL 184
R-1
R-5
R-10
R-15
R-20
R-25
E 592000
E 593000
E 594000
E 595000
E 596000

PLATE 11

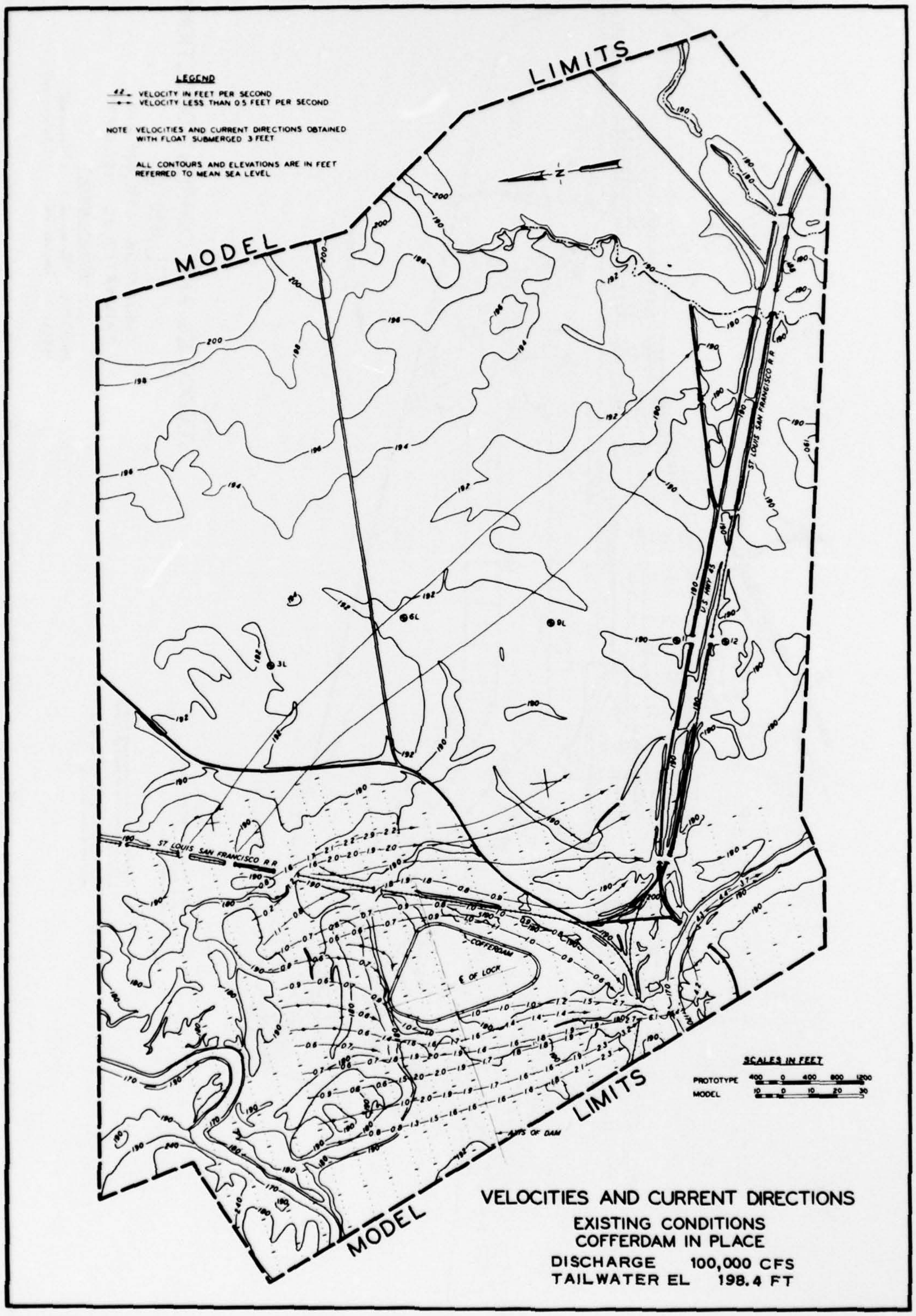

LEGEND
VELOCITY IN FEET PER SECOND
VELOCITY LESS THAN 0.5 FEET PER SECOND
NOTE VELOCITIES AND CURRENT DIRECTIONS OBTAINED WITH FLOAT SUBMERGED 3 FEET
ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL
MODEL LIMITS
ST LOUIS SAN FRANCISCO R R
U S HWY 45
COFFERDAM
SCALES IN FEET
PROTOTYPE
MODEL
VELOCITIES AND CURRENT DIRECTIONS
EXISTING CONDITIONS
COFFERDAM IN PLACE
DISCHARGE 100,000 CFS
TAILWATER EL 198.4 FT

PLATE 12

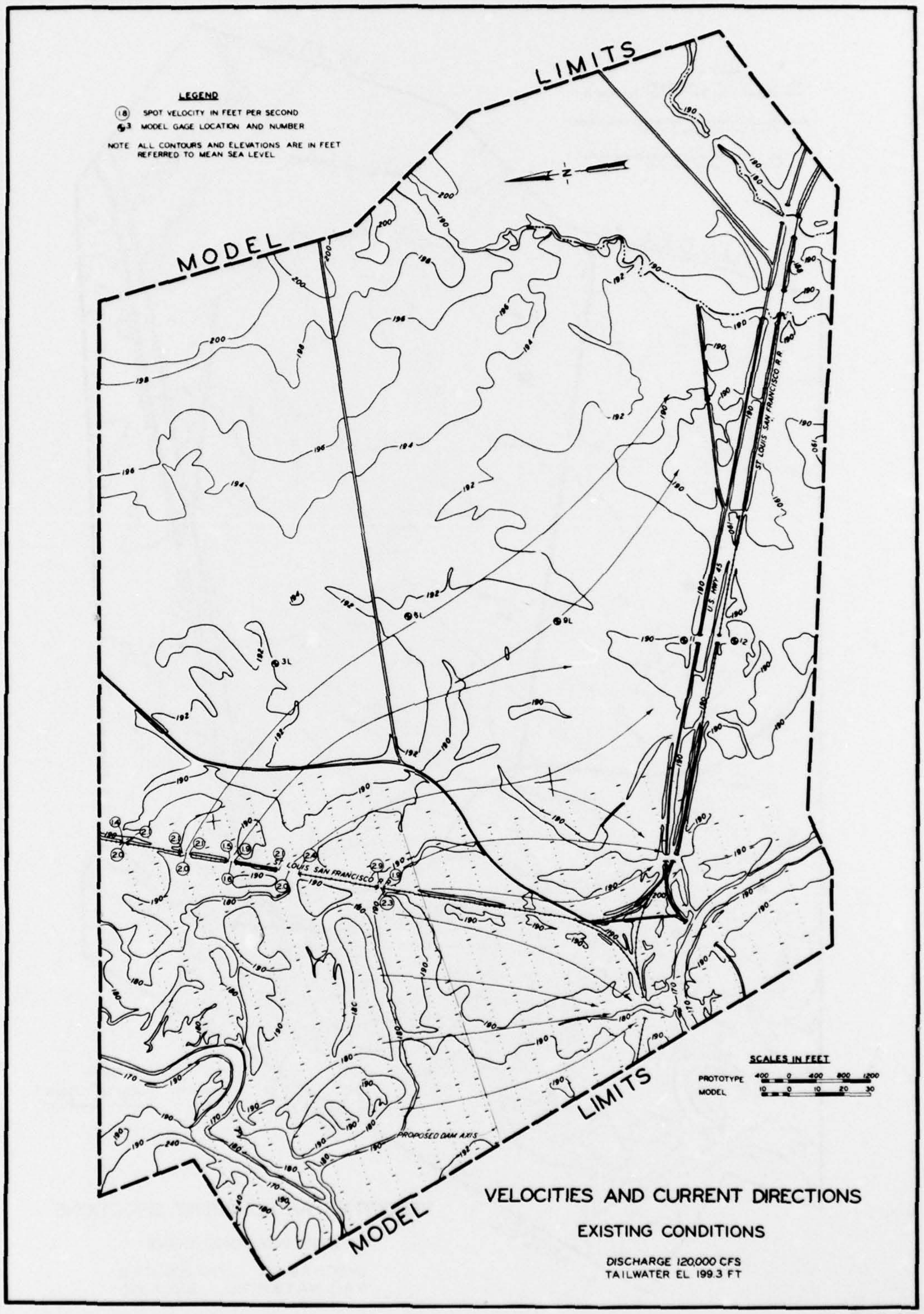
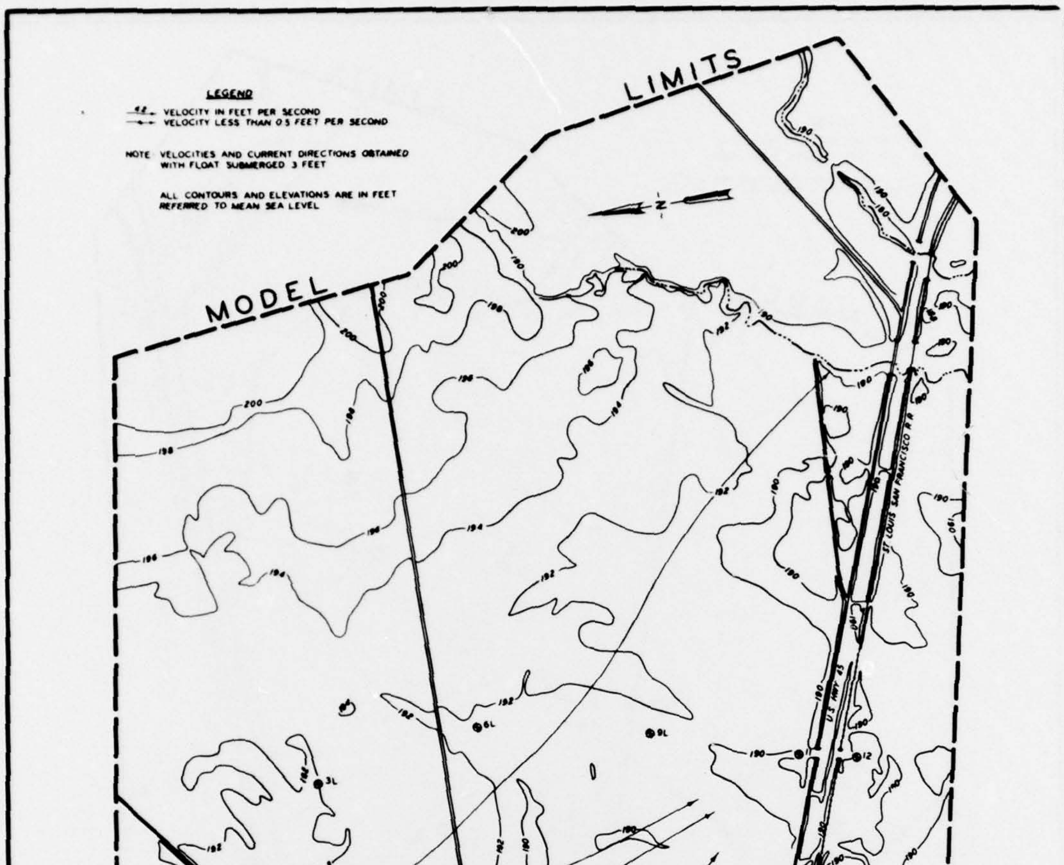

LEGEND
SPOT VELOCITY IN FEET PER SECOND
MODEL GAGE LOCATION AND NUMBER
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL
MODEL LIMITS
ST LOUIS SAN FRANCISCO R.R.
U.S. HWY 65
PROPOSED DAM AXIS
SCALES IN FEET
PROTOTYPE
MODEL
VELOCITIES AND CURRENT DIRECTIONS
EXISTING CONDITIONS
DISCHARGE 120,000 CFS
TAILWATER EL 199.3 FT

PLATE 13

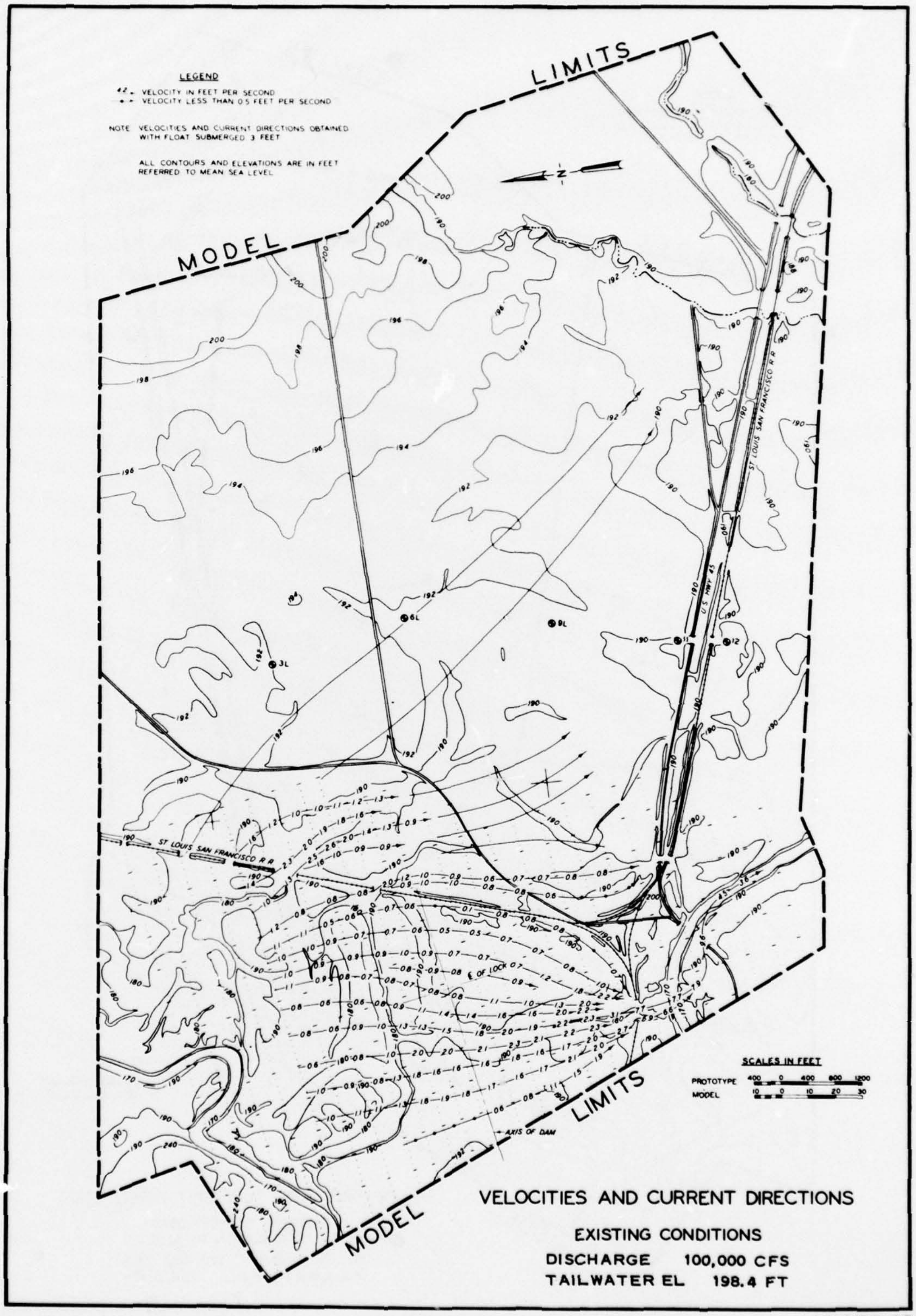


VELOCITIES AND CURRENT DIRECTIONS

EXISTING CONDITIONS

DISCHARGE 150,000 CFS
TAILWATER EL 200.7 FT

PLATE 14



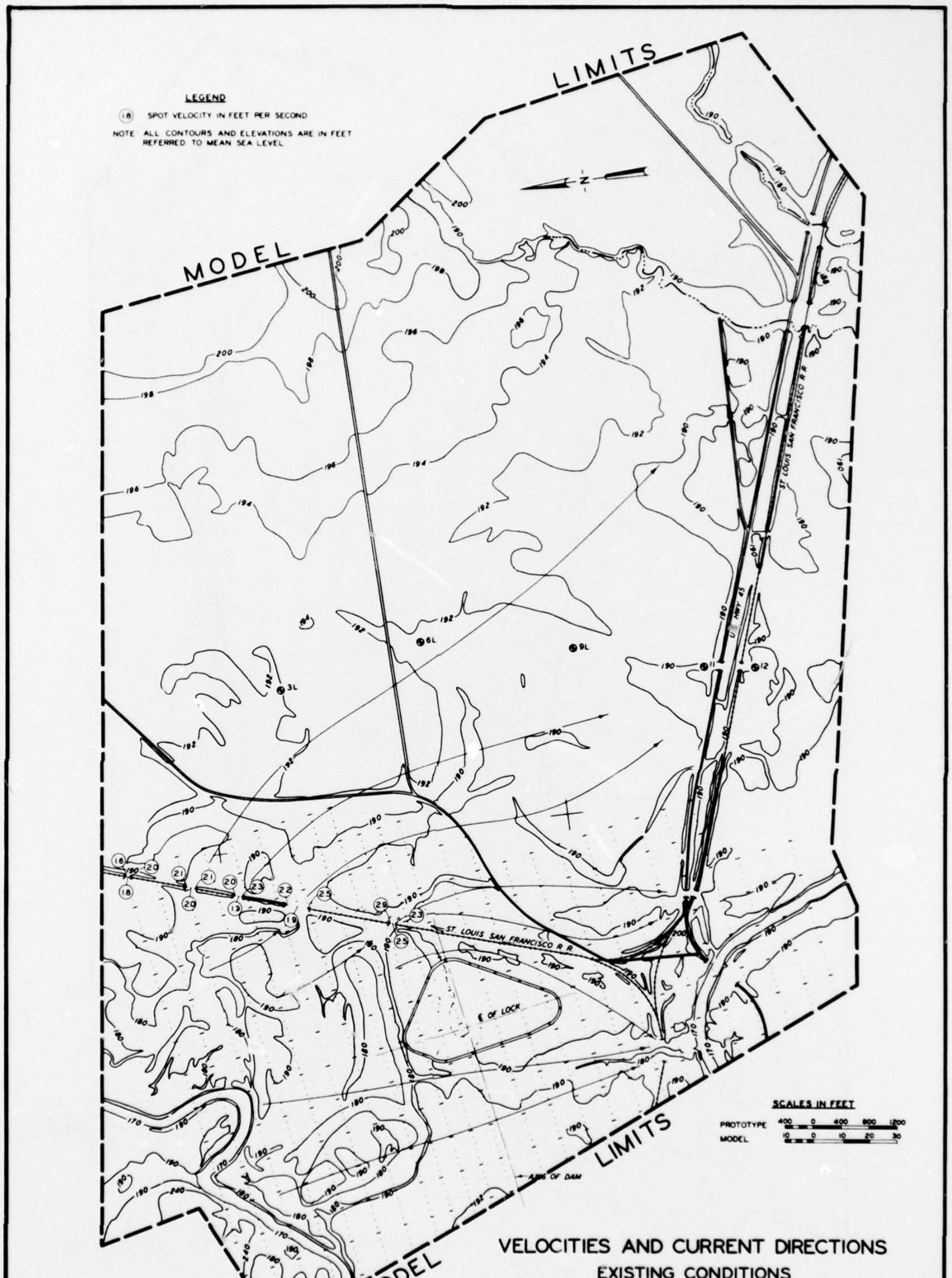
VELOCITIES AND CURRENT DIRECTIONS

EXISTING CONDITIONS

DISCHARGE 100,000 CFS

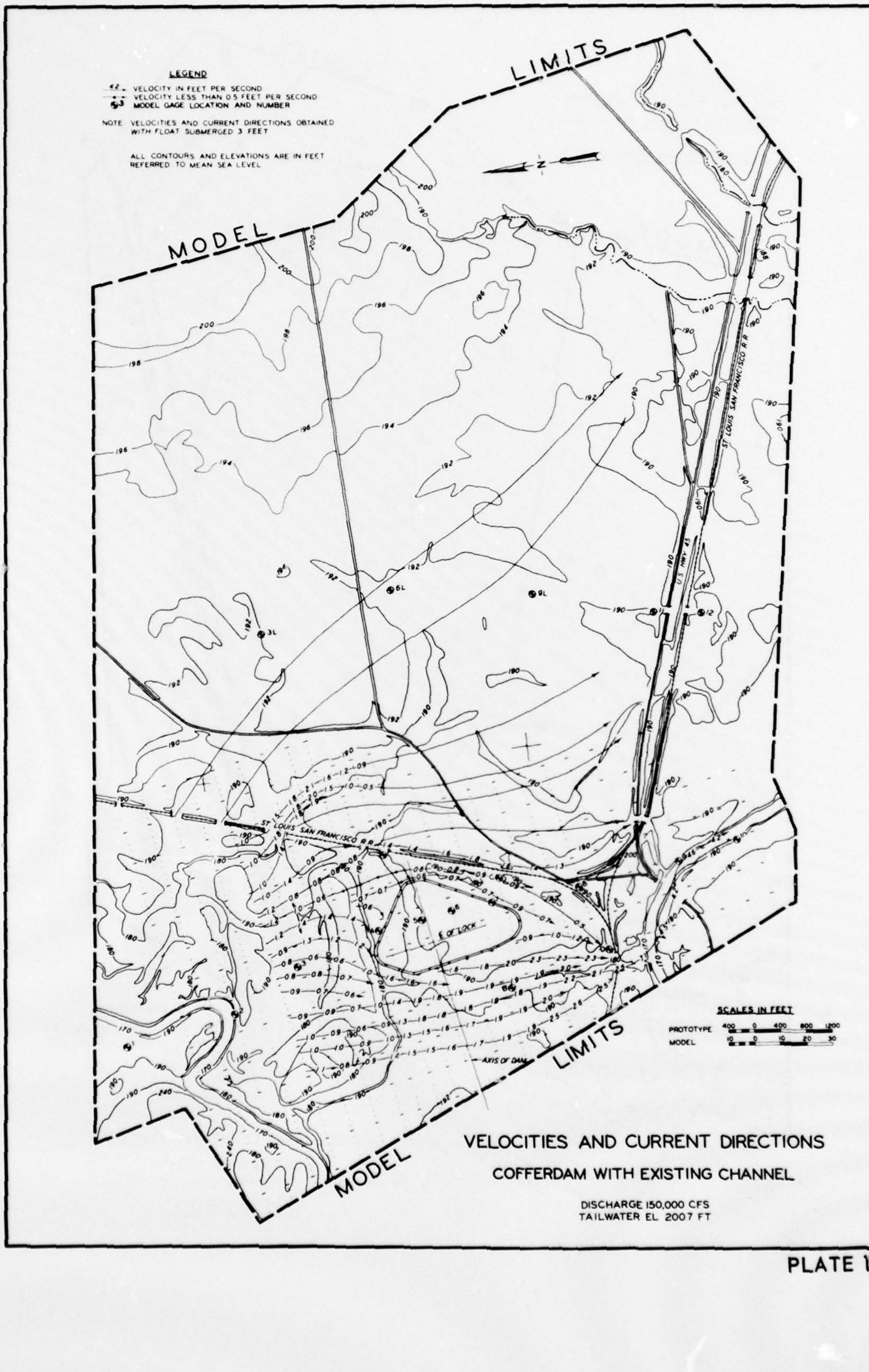
TAILWATER EL 198.4 FT

PLATE 15



VELOCITIES AND CURRENT DIRECTIONS
EXISTING CONDITIONS
COFFERDAM IN PLACE
DISCHARGE 120,000 CFS
TAILWATER EL 199.3 FT

PLATE 16

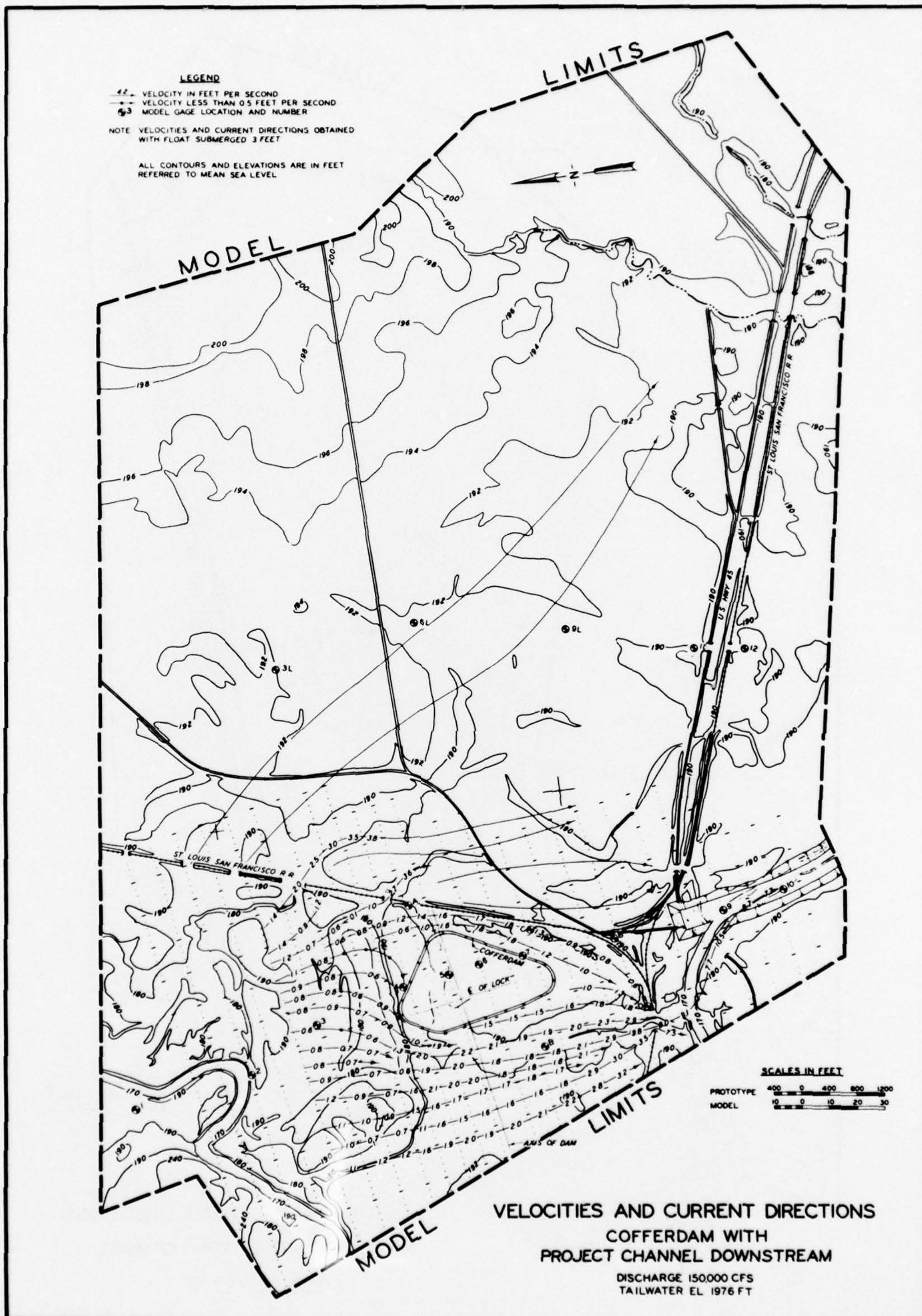


VELOCITIES AND CURRENT DIRECTIONS

COFFERDAM WITH EXISTING CHANNEL

DISCHARGE 150,000 CFS
TAILWATER EL 200.7 FT

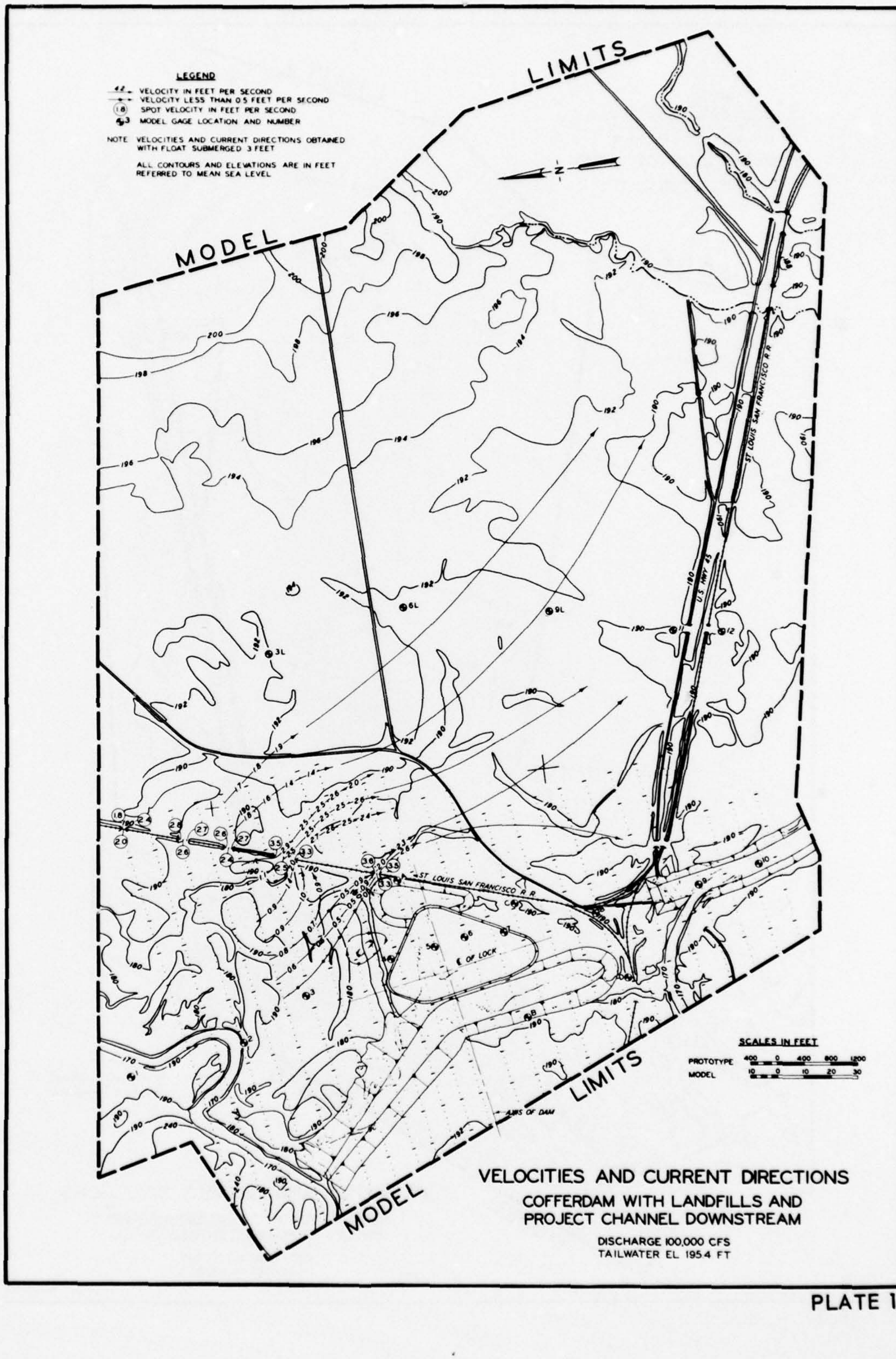
PLATE 17



VELOCITIES AND CURRENT DIRECTIONS
COFFERDAM WITH
PROJECT CHANNEL DOWNSTREAM

DISCHARGE 150,000 CFS
TAILWATER EL 197.6 FT

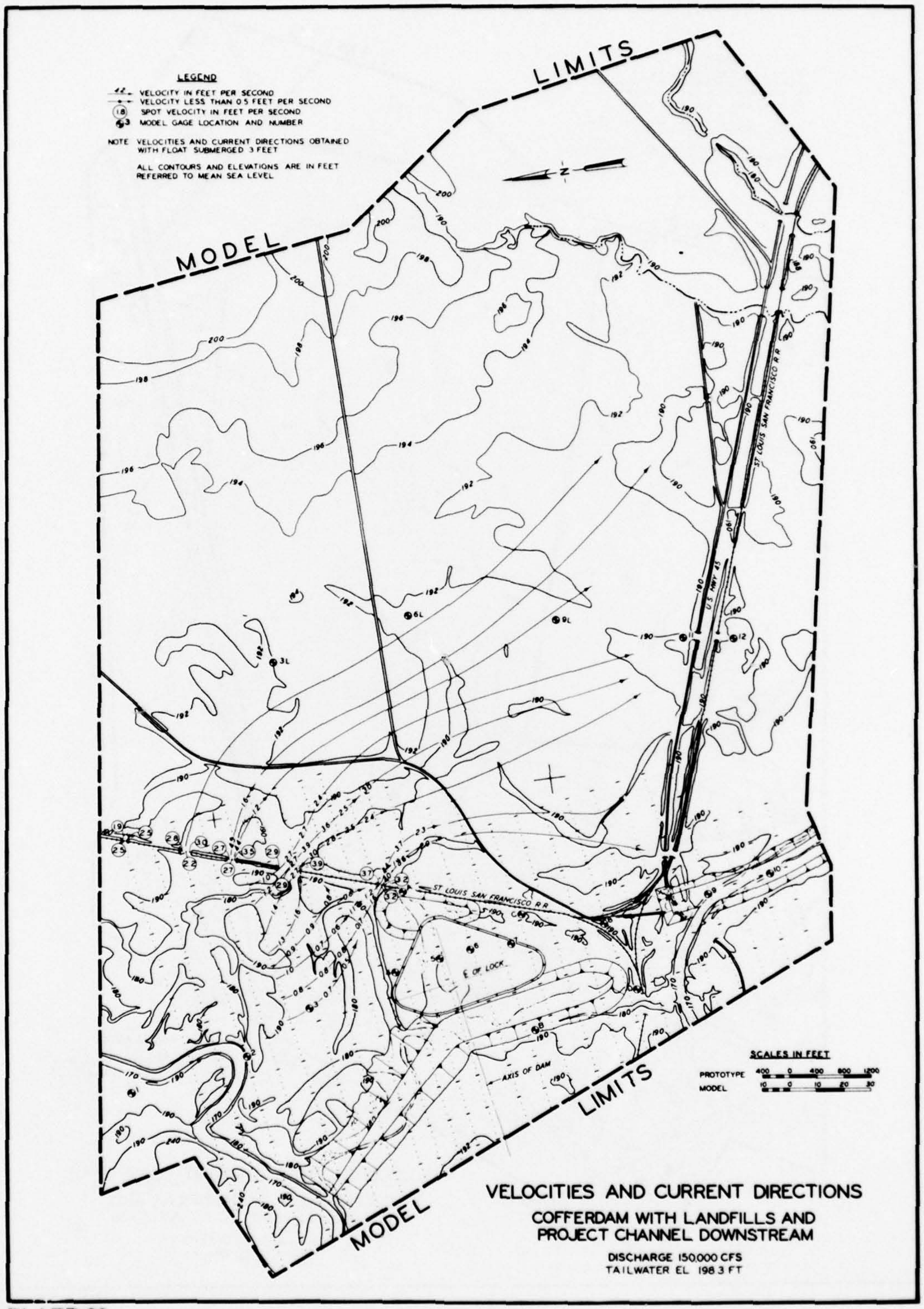
PLATE 18



VELOCITIES AND CURRENT DIRECTIONS
COFFERDAM WITH LANDFILLS AND PROJECT CHANNEL DOWNSTREAM

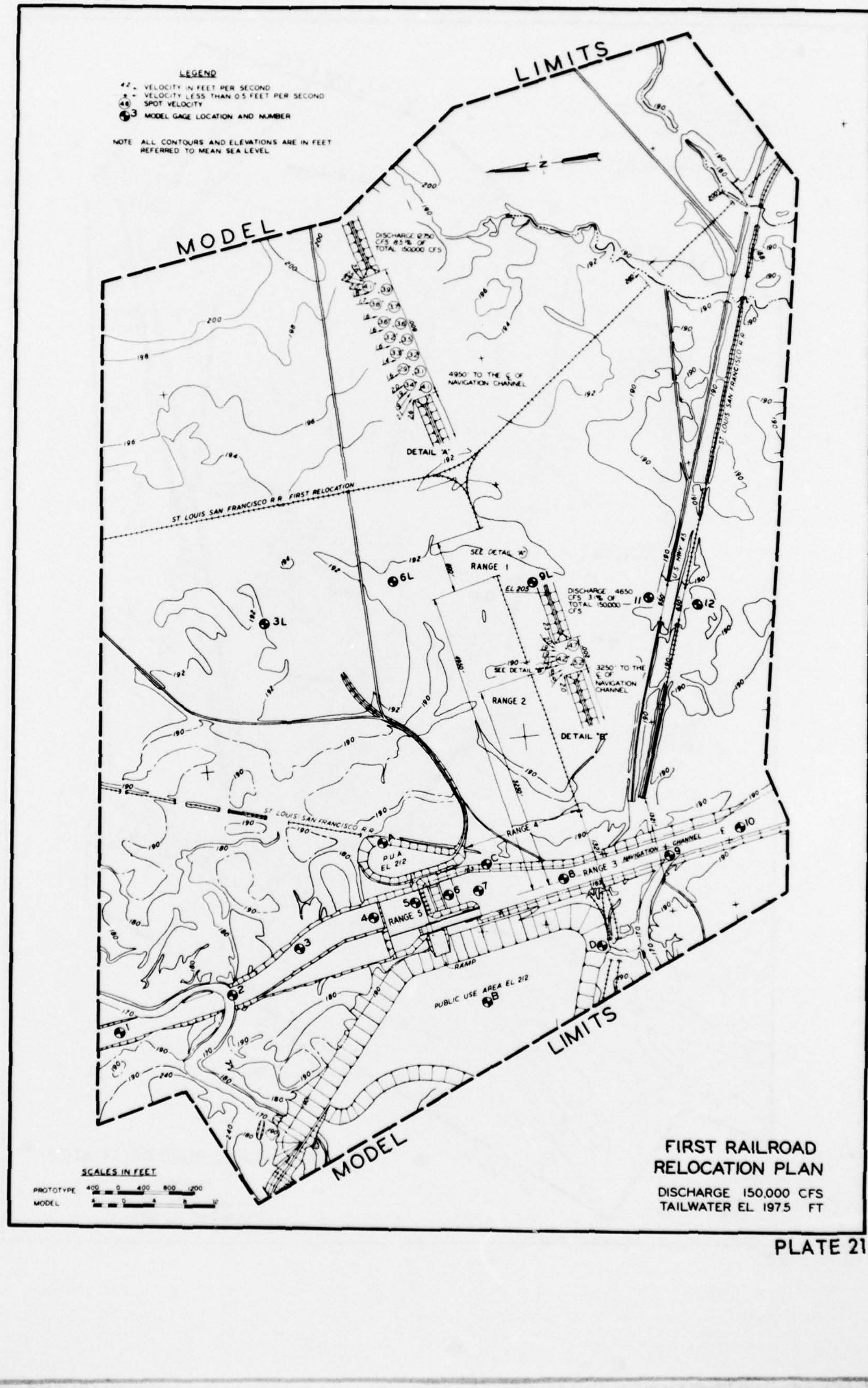
DISCHARGE 100,000 CFS
TAILWATER EL 195.4 FT

PLATE 19



VELOCITIES AND CURRENT DIRECTIONS
COFFERDAM WITH LANDFILLS AND PROJECT CHANNEL DOWNSTREAM
DISCHARGE 150,000 CFS
TAILWATER EL 198.3 FT

PLATE 20



FIRST RAILROAD RELOCATION PLAN

DISCHARGE 150,000 CFS
TAILWATER EL 197.5 FT

PLATE 21

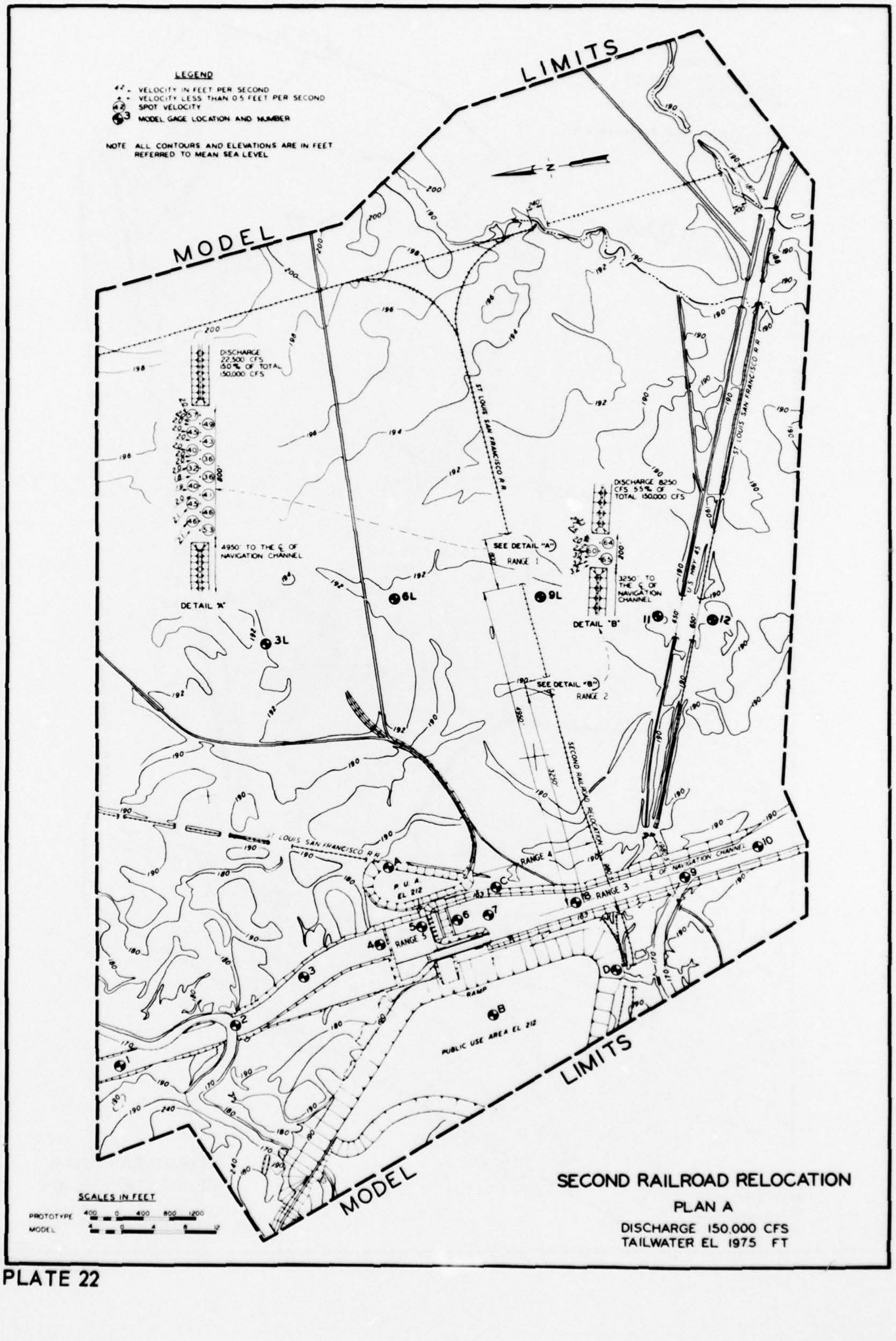
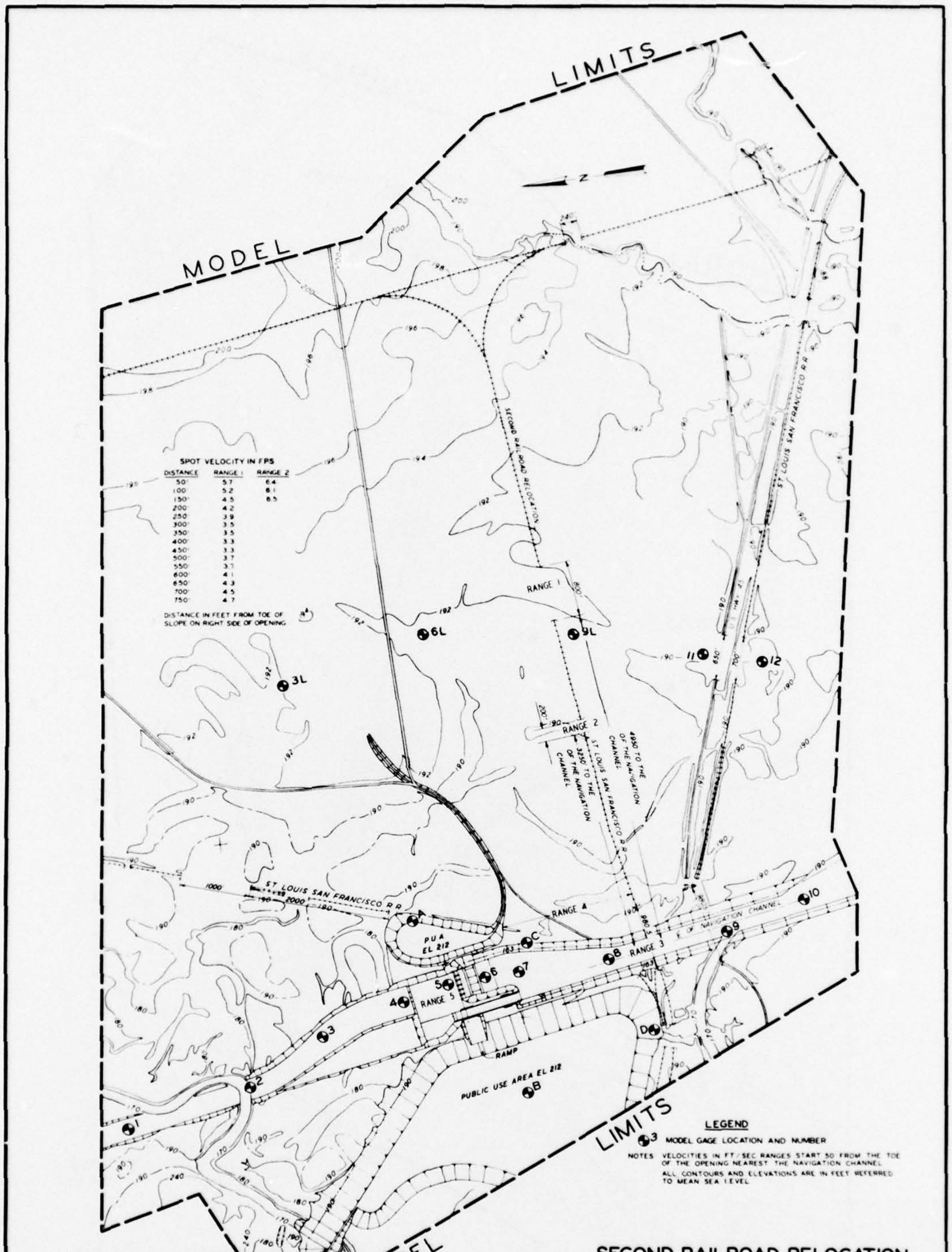

LEGEND
VELOCITY IN FEET PER SECOND
VELOCITY LESS THAN 0.5 FEET PER SECOND
SPOT VELOCITY
MODEL GAGE LOCATION AND NUMBER
NOTE ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL
MODEL LIMITS
DISCHARGE 22,500 CFS 15.0% OF TOTAL 150,000 CFS
4950' TO THE ℄ OF NAVIGATION CHANNEL
DETAIL "A"
DISCHARGE 8250 CFS 5.5% OF TOTAL 150,000 CFS
3250' TO THE ℄ OF NAVIGATION CHANNEL
DETAIL "B"
SEE DETAIL "A"
RANGE 1
SEE DETAIL "B"
RANGE 2
RANGE 3
RANGE 4
RANGE 5
ST LOUIS SAN FRANCISCO R.R.
SECOND RAILROAD RELOCATION
U.S. HWY 45
℄ OF NAVIGATION CHANNEL
P.U.A. EL 212
RAMP
PUBLIC USE AREA EL 212
SCALES IN FEET
PROTOTYPE
MODEL
SECOND RAILROAD RELOCATION
PLAN A
DISCHARGE 150,000 CFS
TAILWATER EL 197.5 FT

PLATE 22



SPOT VELOCITY IN FPS

DISTANCE	RANGE 1	RANGE 2
50'	5.7	6.4
100'	5.2	6.1
150'	4.5	6.5
200'	4.2	
250'	3.9	
300'	3.5	
350'	3.5	
400'	3.3	
450'	3.3	
500'	3.7	
550'	3.7	
600'	4.1	
650'	4.3	
700'	4.5	
750'	4.7	

DISTANCE IN FEET FROM TOE OF SLOPE ON RIGHT SIDE OF OPENING

SECOND RAILROAD RELOCATION
PLAN B
DISCHARGE 150,000 CFS
TAILWATER EL 197.5 FT

PLATE 23

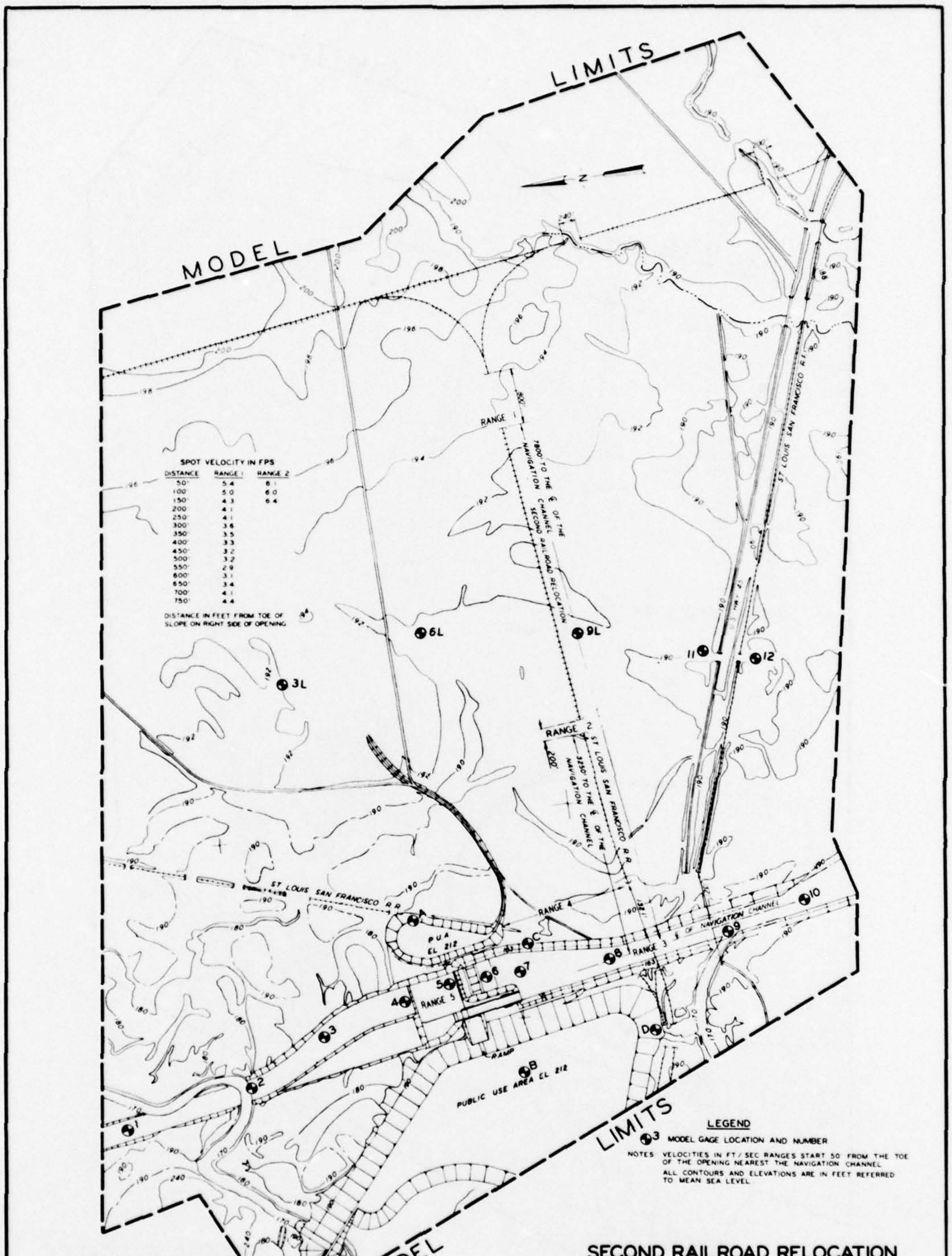
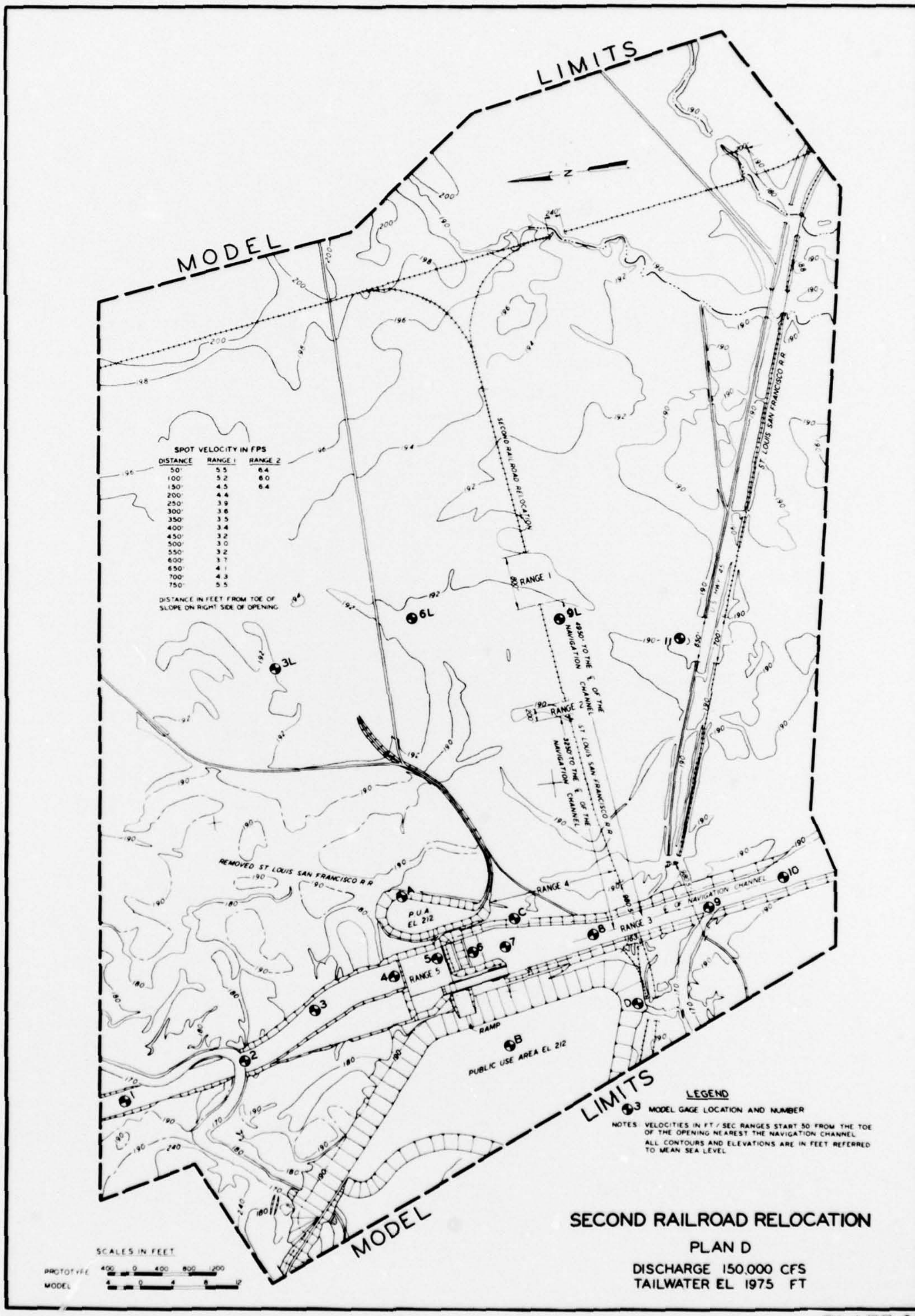

MODEL LIMITS
MODEL LIMITS
SPOT VELOCITY IN FPS
DISTANCE RANGE 1 RANGE 2
50' 5.4 6.1
100' 5.0 6.0
150' 4.3 6.4
200' 4.1
250' 4.1
300' 3.6
350' 3.5
400' 3.3
450' 3.2
500' 3.2
550' 2.9
600' 3.1
650' 3.4
700' 4.1
750' 4.4
DISTANCE IN FEET FROM TOE OF SLOPE ON RIGHT SIDE OF OPENING
RANGE 1
7800' TO THE ℄ OF THE NAVIGATION CHANNEL
SECOND RAILROAD RELOCATION
RANGE 2
3250' TO THE ℄ OF THE NAVIGATION CHANNEL
ST LOUIS SAN FRANCISCO R.R.
RANGE 3
RANGE 4
RANGE 5
NAVIGATION CHANNEL
P.U.A. EL 212
RAMP
PUBLIC USE AREA EL 212
3L
6L
9L
LEGEND
MODEL GAGE LOCATION AND NUMBER
NOTES: VELOCITIES IN FT/SEC RANGES START 50' FROM THE TOE OF THE OPENING NEAREST THE NAVIGATION CHANNEL.
ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO MEAN SEA LEVEL.
SCALES IN FEET
PROTOTYPE
MODEL
SECOND RAILROAD RELOCATION
PLAN C
DISCHARGE 150,000 CFS
TAILWATER EL 197.5 FT

PLATE 24



SPOT VELOCITY IN FPS

DISTANCE	RANGE 1	RANGE 2
50'	5.5	6.4
100'	5.2	6.0
150'	4.5	6.4
200'	4.4	
250'	3.9	
300'	3.6	
350'	3.5	
400'	3.4	
450'	3.2	
500'	3.0	
550'	3.2	
600'	3.7	
650'	4.1	
700'	4.3	
750'	5.5	

DISTANCE IN FEET FROM TOE OF SLOPE ON RIGHT SIDE OF OPENING

SECOND RAILROAD RELOCATION

PLAN D

DISCHARGE 150,000 CFS

TAILWATER EL 197.5 FT

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Shows, Louis J

Navigation conditions at Aberdeen Lock and Dam, Tombigbee River, Mississippi and Alabama; hydraulic model investigation / by Louis J. Shows, John J. Franco. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1978.

38, [10] p., 25 leaves of plates : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; H-78-12)

Prepared for U. S. Army Engineer District, Mobile, Mobile, Alabama.

1. Aberdeen Lock and Dam. 2. Hydraulic models. 3. Locks (Waterways). 4. Navigation conditions. 5. Navigation dams. 6. Tombigbee River. 7. Tennessee-Tombigbee Waterway. I. Franco, John J., joint author. II. United States. Army. Corps of Engineers. Mobile District. III. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; H-78-12.

TA7.W34 no.H-78-12

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